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(71) Applicant and
(72) Inventor: **BADARNEH, Ziad** [NO/NO]; Carl Kjelsensvei 34, N-0874 Oslo (NO).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **ELLIS, Campbell** [AU/NO]; Tøyengata 15A, N-0190 Oslo (NO). **HANSEN, Benedict, J., M.** [NO/NO]; Kjelsåsveien 136, N-0491 Oslo (NO).

(74) Common Representative: **HANSEN, Benedict, J., M.**; Kjelsåsveien 136, N-0491 Oslo (NO).

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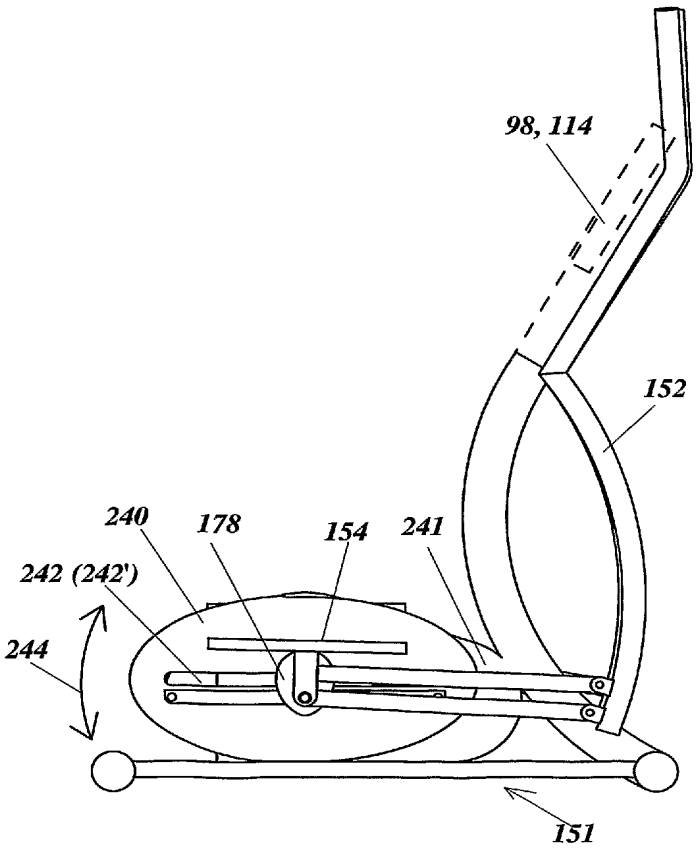
(54) **Title:** A MOTION DEVICE AND APPARATUS FOR PHYSICAL EXERCISE



(57) **Abstract:** A motion device and training apparatus for physical exercise or training and with means which provide for a plurality of different workout options simulating human physical movements, said apparatus having a mechanical motioning device connectable to feet supports for a user in order to drive the motion device. The apparatus has input, control and adjustment means of the motion device related to one or more of paths of motion or style of training related to walking, jogging, running, climbing or skiing; stride length, angle of orbital or rectilinear path relative to the horizontal, maintenance of posture of feet support during movement through a path, change of posture of feet support means through movement along the path, level of brake force acting on an apparatus flywheel, personal workout levels, caloric burn rates, heart or pulse rate, physical condition of user. Adjustment is made possible during an ongoing exercise.

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A MOTION DEVICE AND APPARATUS FOR PHYSICAL EXERCISE.

Field of the invention

The present invention relates to a motioning device with foot supports for use in training apparatus for physical exercise, as defined in the introductory part of the attached independent claims. The invention is useful to provide for a choice among a plurality of different workout options related to simulation of movements, and to provide means for adjustment thereof according to user defined options.

Background of the invention

The benefits of regular aerobic exercise are well established and accepted. Because the major population in the western world live close together in towns and cities, far from the countryside and because of inclement weather, time constraints and for other reasons, it is not always possible to walk, jog, run or ski outdoors. Various types of indoor exercise equipment have been developed for aerobic exercise and to exercise leg muscles commonly used in walking, running, skiing, and other outdoors activities. Such apparatus include treadmills, stepping machines, and various types of sliding machines. Although effective to some extent, they all have disadvantages. Treadmills have the drawback of producing high impact on the user's hips, back, legs and knees. One approach that minimizes the tear on joints is to use a stair stepper. Stair steppers, however, do not develop all of the muscles commonly used in running. Furthermore, such machines are difficult to use in sprint type exercises. Finally, apparatus of the sliding type require the user to slide his/her feet back and forth along a horizontal plane. Such movement does not mimic running and thus offers exercise only to a limited range of muscles.

Combining these kinds of apparatus with an indoor training bicycle one would hope to have a variety of training options for aerobic exercise. This however would require a lot of floor space. To give a maximum aerobic exercise, combined with a simulation of walking, jogging and running without straining the users joints and to save floor space,

there has for long been a need to provide an improved range of a new type of training apparatus often denoted as elliptical trainers or cross trainers.

There is thus a great demand for training equipment capable of simulating a movement of the legs and feet, as they naturally would move when walking, jogging, running, skiing, climbing or performing a range of stepping motions. A single apparatus capable of providing to highly satisfactory degree exercise assistance to such large variety of simulated movements is yet to be found on the market.

On the market today there is however available some exercise equipment of elliptical or cross trainer type aiming to provide such assistance, although so with more or less success. Worth mentioning as examples are products from Tunturi, LifeFitness, Icon and Precor. The aim of these trainers is to achieve an elliptical like orbit of user's feet during a workout similar to that commonly encountered during walking or running. Since the user's feet never leave the foot rails, minimal impact is produced. Training apparatus creating an orbit to pedals or platforms in an elliptical shape, are more than often built quite big to the required stride length. They also often have big crank wheels and many bars linked to each other and such trainers have limited means for adjustment of stride length and orbit of the pedals or platforms.

The present invention thus intends to solve inherent shortcomings of currently available exercise apparatus, and the present invention therefore intends to provide various embodiments of a single multifunctional piece of equipment or exercise apparatus which may be utilised to assist simulation of different exercises, including walking, jogging, running, skiing and climbing without imparting shock to the user's body joints in the manner of exercise treadmills. The inventive apparatus replaces treadmills, all types of steppers, elliptic operation type of apparatus, cross trainers, skiing exercise apparatus and various types of indoors training bikes.

The invention utilizes principles of transforming guided reciprocating members fixed to a bar, arm or any piece connected at a minimum of two locations, in to a variation of linear, elliptical and circular motions to at least one part of the bar, where according to

the invention a foot support would be located. A pair of such arms with foot supports is connected forming a motioning device on an exercise apparatus; the motions provided ranging from circular and elliptical to linear, simulating walking, jogging, running, climbing and skiing. The principle is used in ellipse drawing tools. See for example the principle at www.flying-pig.co.uk/mechanism.

However, contrary to versatility of the apparatus of the present invention, neither of the mentioned prior art exercise apparatus, nor other prior art devices are capable of achieving an optimal elliptical movement with means for easily adjustments of the path and motion in the way the present invention provides, and through use of an elected embodiment of exercise apparatus according to the invention being able to provide the great variety of assistance to simulated movements required for efficient and correct and optimal physical training, exercise or therapy.

Another aspect of the invention is strengthening of the joints and more specifically the muscles and tendons. Training during instability, also called proprioseptive training, has shown positive effects strengthening the muscles round joints. A medical study using unstable pedals during training proves significant results. Such pedals are shown in publication WO00/68067 assigned Flexiped AS. The medical test mentioned was published in Scandinavian Journal of Medicine and Science in Sports, Vol. 13, issue 4, August 2003, author: Dr. Per Høiness. The present invention offers inclusion of elements of instability, specifically regarding supporting means for the feet. The feet supports will optionally be able to tilt transversely of the path of motion, and in addition have the ability to tilt parallel to the path of motion, to give a toe-heel movement.

In a preferred embodiment of the invention it is intended to provide an exercise apparatus with assisting handles for arm movement and for assisting in simulating a range of stepping motions, including walking, jogging, running, climbing and skiing, and with means for manually or automatically adjusting motions from a linear to elliptical path or elliptical like path to the footrest for user's feet.

Objects of the invention

It is thus an object of the present invention to provide improved training and exercise apparatus that provides for a plurality of motions ranging from linear to elliptical or circular to elliptical like movement of feet similar to that of walking, jogging, running, climbing and skiing.

Another object of the present invention is to provide the above training apparatus with means for producing any desired path or movement wanted by the user, and more specifically provide for selective adjustment to match e.g. stride of the user, size of orbit and the type of exercise chosen, preferably with automatically means.

Yet another object of the present invention is to provide a controlled posture and angle of the feet supports related to the exercise apparatus to match the stride and any movement required by the user.

Yet a further object of the present invention is to provide tilting of feet supports being operative on the exercise apparatus to create a degree of instability, which imposes challenges to the muscles and balance of the user.

Still another object of the present invention is to provide a training apparatus, which requires minimal space to operate and store, yet is still easy to operate, simple and reliable in operation and maintenance, and provides a cost-efficient piece of training apparatus capable of providing a greater variety of modes of use in a single piece of equipment compared with prior art devices.

Further, the present invention also aims at providing a motion device useful for the training and exercise apparatus and which provides for a greater range of modes of use, and is capable of contributing to the versatility previous unknown to a single piece of apparatus for training and physical exercise.

Brief summary of the invention

The invention provide motions which are produced by a mechanism, which on each side of a rotational centrepiece, as a propeller like piece, crank or disc or wheel, is connected with arms with means for feet support. The arms have members which reciprocate in slots or tracks and thus produce a variety of cycle paths for the feet supports when set in a revolving motion. The location of feet supports on each arm decide the size and pattern of path cycle which described by the feet supports when set in motion. The centre of path of cycle always in centre of motion of the feet supports.

The feet supporting means in form of platforms have optional tilt movement with an adjustable mechanism, the movement transverse the cycle and stepping motion, for utilising proprioseptive training and exercise.

The exercise apparatus will in a preferred embodiment include handlebars, which move as part of a training exercise. The handle bars would be pivotally fixed to a forward part of the training apparatus and hinged to bars linked to rotational parts of the motioning device in such a way that the bars move in an opposite direction relative to the feet supports giving a full cardiovascular workout.

In a further aspect of the present invention, a flywheel is mounted on a portion of the frame connected so to rotate as result of the crank movements. The flywheel serves as a momentum-storing device to simulate the momentum of the body during various stepping motions. Resistance may be applied to the rotation of the flywheel, to make the motion harder or easier to achieve. This resistance may be co-ordinated with the workout level desired by the user. Similar kind of system is found on training/exercise apparatus, such as ergo-meter bikes, spinning bikes, cross trainers and the like.

Finally the exercise apparatus includes a user input, monitoring and control device, hereinafter referred to as a man machine interface device (MMI) which allows the user to adjust the machine so to achieve desired motion, speed, resistance and path, it being

walking, jogging, running, climbing or skiing. The MMI device is preferably of a touch-screen type but could also be a combination of a display/screen and a panel of buttons.

The characteristic features of the motioning device and training apparatus will appear from the attached independent claims, and further embodiments thereof will appear from the related sub-claims. Also, these and other features and related advantages of the present invention will be apparent from the attached drawings and description to follow.

Brief description of the drawings

The technical features of the invention, the wide range of exercise modes offered, and the inherent improvements over the prior art will be described with reference to accompanying drawings, which illustrates preferred embodiments of the invention by example and in which:

Fig. 1 shows principle of prior art;

Fig. 2a-2b show definitions of the inventive motion device;

Fig. 3 shows a schematic drawing representing a first embodiment of the inventive motion device;

Fig. 4 shows a schematic drawing representing a second embodiment of the inventive motion device;

Fig. 5 shows a schematic drawing representing a third embodiment of the inventive motion device;

Fig. 6 illustrates angles and inclination produced by the inventive motioning device;

Fig. 7 shows mechanism for adjusting angle of inner frame and tracks relative to outer supporting frame of the motioning device;

Fig. 8 shows toe heel motion of feet supports;

Fig. 9 shows training apparatus with the motioning device according to the invention and the mechanism creating toe heel motion to the feet supports;

Fig. 10 shows an example of flywheel and resistance mechanism for the inventive motioning device;

Fig. 11 shows a block schematic of the motioning device and interface system in a training apparatus with the inventive motioning device;

Figs. 12 and 13a - 13e show a foot support platform with tilt function;

Fig. 14 shows side view of training apparatus with the motioning device according to the invention, the apparatus a variation of apparatus shown in fig. 9;

Fig. 15 shows an exploded view of apparatus shown in fig. 14;

Fig. 16 shows an exploded view of the motioning device as used in apparatus shown in figs. 14 -21;

Fig. 17 shows a rear view of motioning device and platforms of apparatus shown in figs. 14 - 21;

Fig. 18 shows an exploded view of platform and handlebar linkage of apparatus shown in figs 14 - 21;

Fig. 19a, 19b show means for adjusting incline by rotation of the motioning device;

Fig. 20a - 20c show means for adjusting feet support position on arms of the motioning device according to the invention;

Fig. 21a, 21b show a training apparatus with motioning device according to the invention, the motioning device hidden inside covers;

Fig. 22a - 22b show a variation of platform and handlebar linkage for toe heel definition for apparatus as shown in figs. 14-21;

Fig. 23 and 24 shows exploded views of assembly for toe heel definitions as shown in fig. 22a - 22b.

Detailed description of the invention

The following description with accompanying drawings will disclose how a motion device for a training apparatus according to the invention is built and will work. The main object of the motion device is to produce elliptical motion to feet supports of an exercise apparatus. The motion is created from at least one reciprocating member guided in a track, the member fixed to a bar or arm supporting a foot support. Fig. 1a-1h show schematically the principle where a bar 1 has two members 3 and 4 which are guided in tracks 6 and 7. At a portion of bar 1 is fixed a pedal 8 (for illustrative purposes). When pedal is forced as indicated by arrow 11, member 3 and 4 will slide along tracks 6 and 7 as indicated by arrows 12 and 13 as shown on fig. 1b. The turning point of member 4 shown on fig 1a. Fig. 1a to fig. 1h show the pedal describing an elliptic path 16 through a full orbit. Fig. 1c shows a first turning point for member 3, member 4 continuing in the same direction as shown in figs. 1a and 1b. Member 3 however changes its direction, as indicated by arrow 14 in fig. 1d. Shown in fig. 1e and 1f member 4 changes its direction indicated by arrow 18 as member 3 continues in the same direction as shown in fig 1d. The second turning point of member 3 is shown on fig 1g. The orbital path of pedal is dependent on location along bar 1 relative to members 3 and 4.

Fig. 2a-b show the dimensions within the motion device according to the invention.

As shown in fig. 2, whether an elliptic or circular orbit or linear track will be described by the foot supports, as pedals 23 when in motion, is the result of choice of distance D between arm 1 centre of rotation 22 and location of feet support 23. The overall dimensions is dependent of radius R which always is the same as R' and R", D dependent of R+E.

Thus, as disclosed in fig. 2, SL is length of path (orbital or rectilinear) described by the feet supports or pedals, i.e. the stride length, and SH is height of path (orbital or rectilinear). The formula is as follows: SL = 2 x (R x 2) + 2 x E and SH = 2 x E.

The following equations (Eq. 1 - Eq. 4) will determine the orbital paths;

Eq. 1; If E = 0, eg. the foot support is located at member 4, (D=R), it is seen that SH = 0, and the foot support obtains a linear path rather than an elliptic or circular path, and that SL will be 2 x (R x 2).

Eq. 2; If E > 0, e.g. the foot support is located at distance D (R+E) from 22, it is seen that SH = 0, that the foot support obtains an elliptic path, and that SL will be 2 x (R x 2) + 2 x E.

Eq. 3; If foot support is located at 22 a circular path is obtained.

Eq. 4; If foot support is located between 22 and member 4, whereas D < R, an elliptic path is obtained, though smaller than in the previous examples, the closer to 22 the foot support is located, the more circular the path is obtained.

So if R = 120mm and E is 60mm (D = 180mm) stride length, SL = 600mm, and stride height, SH = 120mm.

Variation of E and or D relative to R, determine the size and shape of the orbital path of the feet supports of a training apparatus utilizing the motion device according to the invention. The inventive motioning device can be built according to at least 3

embodiments, the difference being number of slots or tracks and corresponding sliding members.

Fig. 3 shows schematically a side view of a first embodiment of the inventive motion device, where a pair of bars or arms 30, 30' is rotateable connected to a wheel 31 which is rotateable located within a frame piece 32, which again is located within frame 36. Connection point numbered 29, is either of an axle type, or of a bearing type. Frame 36 preferably part of a frame to a training apparatus supported by a floor. Each of the arms 30, 30' supports the feet supports 33,33'. The frame piece 32 on each side having a set of tracks or slots; 34,34', (34", 34'" on the other side not visible), 35,35' (34", 34'" on the other side not visible). Arms 30, 30' has members 38, 38', 39, 39', which are guided within the slots 34-34'" and 35-35'" in a manner as explained above relative to figs. 1a-1h.

As fig. 4 suggests number of slots and guided members within the motion device may be increased. Fig. 4 shows a second embodiment of the inventive motion device, which has a duplication of slots and members compared to above disclosed embodiment shown in fig. 3. Arms 40, 40' are rotateable connected to wheel 41, rotateable located within frame piece 42 and frame 36. Connection points are numbered 52, 52'. Each of the arms are numbered 40, 40' and supporting foot supports 43,43'. Frame piece 42 on have on each side eight tracks or slots; 44,44', (44", 44'" on the other side not visible), 45,45' (45", 45'" on the other side not visible), 46,46', (46", 46'" on the other side not visible), 47,47' (47", 47'" on the other side not visible). Arms 40, 40' has members 48, 48', 49, 49', 50, 50', 51,51' which are guided within the slots 44-44'", 45-45'"', 46-46'", and 47-47'", the motion equal to the above explained embodiment.

The members (38-39', 48-51') on the arms (30, 30', 40, 40') of the motion device need to be guided to give wanted support in order to produce the motion desired. The arms (30, 30', 40, 40') are however connected with wheel (31, 41) and therefore each has a fixed support link throughout any revolution of the arms. It is therefore claimed that a motion device according to the invention as a third embodiment may only have one set of tracks of which a member fixed to each of the arms carrying the feet supports, may be guided.

Fig. 5 shows arms 60, 60' rotate ably connected to wheel 61 through axles and or bearings 62, 62'. Wheel 61 is rotate able located within frame piece 65, which is fixed to a main frame 66, which preferably is the main frame of any exercise apparatus which the motion device is part of. It should however be noted that wheel 61 may be replaced by a crank or cross member, as suggested below in fig. 16. The arms has members 63, 63' which are guided in tracks 64, 64' (not shown) located on each side of wheel 61 and frame part 65. Feet supports 67, 67' are located at end portion of arms 60, 60'.

One of the main objects of the invention is to adjust the angle and thus the inclination of the path described by the feet supports when the motion device is revolving. Incline adjustments are performed by turning frame piece 70 (equal to 32, 42, 65) relative to frame 72 (equal to frame 32', 42, 66) indicated with arrow 73 as shown on fig 6, thereby changing the angle of which the orbital path of the foot supports travel. Number 74, 74' 74" on fig. 6 suggests the angles of which is a natural area of which to have the incline work and which applies to all embodiments disclosed in this application. A vertical inclination as suggested by line 74"' is also possible and would make a path for the feet supports simulating a climb situation.

The means of which to turn and stabilize frame piece 70 (equal to 32, 42, 65) relative to frame 72 (equal to frame 32', 42', 66) may be of a level type or by a gearing type, manually operated or assisted by auto means as electric motors. Fig. 7 indicates how a motor 80 with a worm gear 81, connects to a gear 82 which again is connected to teeth on the frame piece 70. Activating automated means as motors and gears may be done by the user from any switch or interface console on the training apparatus utilizing the invention. Fig. 7 indicated by dotted line 76 how the fixing point of feet supports may be altered to change the size and shape of the path cycle of the feet supports as disclosed in figs. 2a-2b. Each foot support may have means for slideable connection to the arm. The slideable action may also be assisted by motors and gearing for an automated adjustment of the feet supports in order to alter path cycles. This feature disclosed in fig. 20 below.

A preferred embodiment of the inventive motion device and exercise apparatus would have means for posture stabilisation, controlling the angle of the foot supports during a revolution of the said device. The feet supports would be of a platform type, as shown below in figs. 12, 13 and preferably held in a horizontal position, or performing a toe heel motion as suggested in fig. 8. The platforms numbered 88, 88', path numbered 89.

The three embodiments disclosed above of the motion device according to the invention is preferably located on a frame which is supported on a floor, the frame forming a basis for an exercise apparatus which in addition to feet supports located on the motion device also has static and or moving handles linked to the motion device to add exercise to arms of the user.

Fig. 9 shows a training apparatus with the inventive motioning device 90 located within the apparatus frame 91. The feet supports are made as platforms 92 and 92'. To each of the platforms there are linkages 94, 94', 95, 95' coupled to bars 96, 96', which are hung on an axle 97 on a forward part of frame 91. The linkages 94, 94', 95, 95' holds the platforms in a toe heel posture, as shown in fig. 8 during a revolution of the motioning device. Fig. 9 also shows fixed handle 98 and handles 99, 99' fixed to bars 96, 96', and which allows a swaying motion to the users arms as part of an exercise. The apparatus also has a flywheel 100 which has means for storing momentum and resistance to the motion of the crank device the resistance created from a so called eddie current system, an electromagnet 104 affecting the flywheel, the level of resistance adjustable from a switch or interface console on the training apparatus. This kind of system of is of prior art, used on a number of exercise apparatus on the market. Fig 10 shows a typical example of how this system could be incorporated within a training apparatus utilizing the motioning device. Flywheel 100 is coupled to the rotational wheel (or crank) 101, which is connected with the arms and feet supports of the motioning device with, as shown in this example a belt 103.

The training apparatus utilizing the inventive motioning device would preferably have means for of adjusting the level of resistance of the motion device. As know from prior art of exercise apparatus.

The apparatus of present invention includes a system for selectively applying the braking or retarding force on the rotation of the crank wheels through for example an eddy current brake system, such as indicated on fig. 10. Such a brake system is known in the art and used on training and exercise apparatus currently on the market. Other brake devices that could be used include using a belt running around the flywheel and provided with means for varying the tensioning, or by using conventional brake shoes interacting with the flywheel. Resistance may be applied to the rotation of the flywheel, to make the motion harder or easier to achieve. This resistance may be co-ordinated with the workout level desired by the user. Similar kind of system is found on training and exercise apparatus, such as ergo-meter bikes, spinning bikes, cross trainers and the like.

It is desirable to monitor the rotational speed of the flywheel or the crank wheels so as to measure the distance travelled by a user of the inventive apparatus and also to control the level of workout experienced by the user. The movement resistance and simulated distance may be co-ordinated with the workout level desired by the user, for instance, a desired heart rate range for optimum caloric expenditure. A heart rate monitor or other sensors may be utilised to sense the desired or required physical parameters to be optimised during exercise. Any standard method of measuring the speed of the flywheels may be utilised. For instance, an optical or magnetic strobe wheel or pattern may be mounted on a disk, or other rotating member, e.g. the wheel 111 (equal to 31, 41, 61, 101) of the present apparatus as shown in fig. 11. An optical or magnetic sensor 112 may monitor the rotational speed of the wheel 111 to generate an electrical signal related to such rotational speed and whereby such signal can be processed by a computer located e.g. on the apparatus.

The object of the invention is to create a training apparatus where the dimension(s) of the orbital or rectilinear path of the foot supporting means are adjustable preferably with auto assisted means. Setting of dimension(s) of the orbit for feet supports can be provided through use of a man machine interface (MMI) device, also referred to as an interface console for user personal adjustments, resistance to work-out, advisor displays,

updated results, suitably including a display with a keypad/buttons or a touch screen for input of user values also referred to as an interface console.

Fig. 11 shows a schematic illustration of a system for automatic, or user defined motion or stride control and adjustment, the figure indicating use of embodiment three as disclosed relative to fig. 5. Speed of the wheel 111 can be measured by a sensor 112 for example directly operative on the wheel 111, axle mounted wheel, flywheel 113 or other parts rotating as result of wheel rotation.

The sensor 112 sends signals to a microprocessor as a CPU included in the interface console 114 of the training apparatus, which through a software program signals means for adjusting arms 116 and 116'. Reference numerals 117 and 117' indicate means for adjustment as indicated on fig. 7, on the outer part of the arms connected with the connection point of the feet supports 119, 119', as indicated on fig 7. Reference numerals 118 and 118' (equal to 63, 63') indicate sliding members fixed to arms 116, 116'. Reference numerals 115, 115' are axles and or bearings connecting arms 116, 116' and wheel 111. Motor 120 is fixed on main frame, 123 and connected to part of frame 121 (as shown in e.g. fig 7) which has slots or tracks (as shown in figs 3-5) here denoted as 124, 124', motor 120 connected with interface console 114 for adjustment of the motion device incline settings. Means for operating is provided in form of an interface console either it be of button clusters with display or preferably in the form of a touch screen 125. Run by a program within the interface console choices are displayed on the screen, for example a user defined adjustment of the stride indicated and adjustable on the console. The interface console is programmed to show the adjustments made by the user on the screen/display. The adjustments made or chosen by the user from the control device is processed by the CPU within the console which process signals to run motors 117, 117' and 120 and power to the motors for settings of motioning device adjustments accordingly. Reference numerals 119, 119' indicating feet supports, numeral 128 indicating an eddie current system, 123 denoted drive means (belt) connecting wheel 111 and flywheel 113.

As shown in fig. 11 the apparatus will have a man machine interface (MMI) or interface console, system for the user. It should be apparent from the above described that on a

screen, for example a touch screen, as part of the apparatus of present invention, a menu system and layout of choices and adjustments would at least show;

- paths of motion or style of training as: walking, running, climbing or skiing;
- individual adjustment of stride length, angle of path;
- level of resistance and other prior art adjustments regarding workout levels, caloric burn rates, heart rates/pulse etc....

The motion device will have means for supporting the feet of a user. Depending on the type of training apparatus the crank device is mounted in, either platforms or pedals are fixed to the crank arms. To gain proprioceptive training, the crank device should have mounted thereon multiple use platforms or pedals.

Figs. 12 and 13 show a platform 130 fixedly attached to a frame 131, the frame 131 being tiltable and fixedly attached on an axle 132 linked to a body 133. The body 133 has a lever 134 tiltable arranged about the axle 132. The frame 131 has a curved track 135 on each side of the body 133, the body having a track 136 radial to the curved track. A bolt 137 runs through and in the tracks. At an uplifted position of the lever 134, see arrow 140 on fig. 13c and 13e, the bolt 137 is forced into the radial track 136 by a spring 2138 and the platform is locked. In a downward position the bolt is forced by the lever into the curved track 135, whereby the platform 130 is free to tilt bound by the length of the track.

The following description and accompanying figures will now disclose a complete training apparatus and motioning device according to the invention. Fig. 14 shows a side view of the training apparatus, wherein a motioning device 150 is mounted on a frame 160 where also a pair of handles 152, 152' are connected. The motioning device has feet support 154, 154' which are connected by linkages 156, 156', 157, 157', to lower parts of the handles 152, 152'. Fig. 15 shows a perspective view where the main groups of the apparatus is shown in an exploded view (only one of the handlebars with linkages and foot support are shown in this view). Frame 151 having a base 160 with supports 161, 161' for contact with floor. The frame 151 has an upwardly part 162 where handles 152, 152' are connected, the location numbered 163. The motioning

device 150 is located on frame base 160 and supported by a bar 164 protruding from upper part of frame. The assembly of the motioning device will now be explained more closely accompanied fig. 16 and 17. Fig. 16 shows one side of the motioning device assembly in an exploded view. A first set of rotational arms 170, 170' are connected to axle 171, which is located preferably on bearings, through motioning device, support frame 172. The arms are shown located within wheels 173, 173', but may alternatively be part of the wheels as a one-piece part. To end parts of each of the arms 170, 170' there are connected a second pair of arms 175, 175', the second pair of arms 175, 175' freely connected to axles 176, 176' and bearings 177, 177'. The second pair of arms each has end parts 178, 178', to which brackets 180, 180 are rotational on axles 179, 179' are connected. The feet supports 154, 154' are fixed to the top parts the brackets. The end parts 178, 178' are each fixed to the outer ends of the second pairs of arms 175, 175' with an axle 181, 181', wheels 183 located on each axle, spacing arms and outer ends. Between the first set of arms 170, 170' and frame 172 there are located a pair of track supports 188, 188', these rotational connected on axle 171. Tracks 189, 189' are fixed to each of the supports 188, 188', making the tracks located between second pair of arms 175. 175' and their outer ends 178, 178', positioning wheels 183, 183' on each of the tracks. Fig. 17 shows a rear end view XVII - XVII as indicated in fig. 14, the fig. showing brackets 180, 180' and feet supports 154, 154' connected to outer end parts 178, 178'. The fig. also shows where the supports 188, 188' are located and connected with tracks 189, 189' through use of bars 190, 190'. Linkages 156, 156', 157, 157' as shown in fig. 14 are connected to the brackets 180, 180' and to the handles 152, 152'. Fig. 18 show in more detail how linkages are connected with brackets 180, 180' and handles 152, 152', the fig. showing one side of the assembly.

The tracks 189, 189' of the motioning device are adjustable, in a manner as previously shown in fig. 6 and 7 and as indicated by arrow 197. Fig. 19a shows a side view of the training apparatus indicating by dotted lines 192, 192', the possible adjustments of the tracks 189, 189' in order to vary the incline of the paths of the feet supports 154, 154' of the apparatus. The supportive means 188, 188' of the tracks 189, 189' are connected to means, which turn and stabilizes the said tracks in the desired position. This may be done in number of known manners. As indicated on fig. 19a bar 190 connecting tracks

189, 189' with supports 188, 188', is guided in a track 194 made in a fixed portion 195 of the frame, or supported on the frame. The bar 190 is lockable along the track 194, using a bolt or threaded bolt 196 with tightening means as a nut or wing screw handle. Fig. 19b show how the tracks may be adjusted by use of a motor 200, which is through gearing link 201, is connected with a threaded bolt or worm gear 202, to a part of the track supports as indicated by number 203. The motor is of electric type and is powered by a battery or by cable to the mains. The motor is also connected with the interface console of the training apparatus, where the user will operate all functions provided by the training apparatus, in a manner as shown in fig. 11.

Fig. 19a also show a flywheel 210 which has means for storing momentum and resistance to the motion of the motioning device the resistance created from an eddie current system, an electromagnet 214, affecting the revolving freedom of flywheel, the level of resistance adjustable from a switch or interface console on the training apparatus. The flywheel coupled to one of wheels 173, 173' by a belt 215. This system is also shown above in fig. 10.

As indicated on fig. 7, it is desirable to vary the path described by the feet supports. Positioning of the feet supports 154, 154' relative to the rotational points of the secondary arms 175, 175' decides the path described by the feet supports as defined above with accompanying figs. 2a, 2b. This may be done by varying the fixing position of the feet supports on the outer end piece 178, 178' of the secondary arms 175, 175'. Fig. 20a-c show a few examples of how this can be done. Fig. 20a shows an outer end piece 220 having a number of holes 221 where axle 222 (similar to axle 179, 179') may be fixed varying the positioning of the feet supports. Dotted line 223 indicating fixing point to secondary arm 175, 175'. Fig. 20b shows an outer end piece 225 where axle 226 for foot support is fixed to a piece 227 slideable connected with main piece 225, lockable in positions in direction indicated by arrow 228 through holes 229 through use of for example a bolt 230. As mentioned above relative to fig. 11 it is desirable to adjust the motioning device from an interface console on an apparatus according to the invention. Fig. 20c shows an outer end piece 232 where piece 233 attached with axle for foot support, is slideable relative to main piece 232. On the main piece 232 is attached a

motor 234 which again is connected to worm gears, or threaded bolts 236, 237 which are connected to slideable piece 233. Activating motor 234 may adjust the slideable piece relative to the length of piece 232, (indicated by arrow 239) and when connected to the motioning device of an apparatus according to this invention, adjusts the path of motion created by the feet supports.

Fig. 21a and 21b shows a design of the training apparatus as shown in figs. 14-20, the motioning device hidden within a cover in two parts 240 and 241. The end parts 178, 178' of secondary arms are located on the outside of said covers, axles 181, 181' moving in slits 242, 242' in the cover 240. The cover 240 moves as indicated by arrow 244 together with the tracks when these are adjusted, cover 241 remains static with the frame 150.

The inventive motion device and apparatus, as indicated above in fig.11, produces a toe heel action. The method for this is shown in figs. 9 and 18, 19, 21, using linkages. Another method using belts or wires are shown below in figs. 22 and 23. Fig. 22a shows training apparatus with the inventive motioning device 150 on frame 151, the feet supports 154, 154' through brackets 180, 180', connected to handles 152, 152' with use of linkage 252, 252'. To the brackets 180, 180' there are fixed wheels 250, 250' which again are connected to wheels 251, 251' fixed to the lower part of handles 152, 152'. Wheels 250, 251 and 250', 251' are connected with wires or belts 254, 254. When the feet supports 154, 154' of the motioning device is set in motion the handles 152, 152' are given a swaying motion which is transferred to wheels 251, 251' and to belts or wires 254, 254 which again turns wheels 250, 250' giving the feet supports a toe heel motion through a revolution of the motioning device.

Fig. 23 shows an exploded view of one side of the handlebar and feet support assembly, the following disclosure applying to both sides of a motioning device and apparatus according to the invention. Wheel 250' is fixed to bracket 180' at 257', rotateable located round axle 179' fixed to outer arm member 178'. Wheel 251' is rotateable connected to axle 258' on bar 152' and fixed on bolt 259' also fixed on handle 152'. Linkage 252' is connected on axle 258' and axle 179' in order to transfer motion

between the handles and motioning device. To adjust the toe heel motion of the feet supports the connection 260' on wheel 251 may be adjusted. Number 260''' indicate additional locations on wheel 251' where bolt 259' can fix wheel 251 to handle 152' in order to adjust the angle of toe heel motion of the foot support 154'. Fig 24 suggests an automated solution where a motor 261' is located on handle 152', is connected to gear 262', said gear connected with gear 263' on wheel 251. Motor 261' is capable of adjusting the positioning of wheel 251' in order to adjust the setting of toe heel motion of feet support 154', the adjustment of settings available from the interface console 98, 114 as described above with relevance to fig. 11.

In the descriptive portion and the following claims feet supporting means or feet supports should be understood as applying to all kinds of pedals, pedal like devices, platforms and other devices for apparatus made for placing feet and stepping on or otherwise moving the feet for turning a crank like device.

The invention described can be subject to modification and variations without thereby departing from the scope of the inventive concept as disclosed with reference to the drawings and further stated in the attached claims. To the extent that certain functional elements can be replaced by other elements to enable the same function to be performed by the various embodiments disclosed, such technical equivalents are included within the scope of the invention.

Claims:

1.

A motion device and training apparatus for physical exercise, which provide for a plurality of paths and different workout options simulating human physical movements of legs and feet; wherein the centre of rotation of said crank or wheel is in the centre of path described by the feet supports, the path representing any orbital or rectilinear description the motion device and training apparatus comprising:

- a pair of arms each rotate able connected to rotational centrepiece as a rotateable propeller piece, crank, disc or wheel, the said arms fitted with feet supports,
- a first frame supporting a second frame where said crank or wheel is located, the second frame rotate able adjustable relative to the first frame,
- at least one pair of members fixed to the arms, the members slideable or rotateable guided in slots or tracks, which are located in or fixed to said second frame.

2.

A motion device according to claim 1, wherein the motion device has means for adjusting an orbital or rectilinear path of said feet supports and it's inclination relative to the horizontal, the means located on at least one of the said frames enabling rotational movement and stabilisation of the second frame relative to the first frame, such rotational movement of the second frame enabling a plurality of angles of the said slots and or tracks of which the members of said arms move.

3.

A motion device according to claim 1 and 2, wherein size of said rotational wheel and radius, from centre of said rotational wheel to point of connection with arm is defined as R and where the motion device has means for adjusting the location of the feet supports along the said arms relative to the arms point of rotation, this defining a distance D between each of the arms point of rotation and the rotational fixing point of each of the feet supports on the arms the size of distance D defining the size and shape of path the feet supports describe;

- D = R gives a linear path,
- D > R gives elliptical orbital paths
- D < R gives elliptic paths, though smaller than if D > R, the closer to D is to R, the more circular path is obtained.
- D = 0 gives a circular path.

4.

A motion device according to claims 1-3, the said members fixed to said arms are made to slide or roll within said slots or tracks, number of members and track and or slots corresponds with number of members.

5.

A motion device according to claim 4, the motion device having one track and one member on each arm.

6.

A motion device according to claim 4, the motion device having four slots and two members on each arm.

7.

A motion device according to claim 4, the motion device having eight slots and four members on each arm.

8.

A motion device according to claims 2-7, wherein tracks are connected to said second frame, said adjustable means comprise a groove located fixed relative to main supportive and first said frame of the motioning device, and a lock and release device which enables movement of tracks relative to the grooves and inclination relative the horizontal.

9.

A motion device according to claims 2-7, wherein tracks or slots are connected to said second frame, the second frame connected to gearing means, which is connected to a motor, which is connected with power, the motor connected to a switch or an interface console.

10.

A motion device according to anyone of claims 1-9, wherein the feet supports have means for posture stabilisation thereof relative to the frame throughout a full movement path cycle of said feet supports.

11.

A motion device according to claim 10, wherein the means for posture stabilisation consist of two pairs of linkages which at the one end parts are connected on a part of each foot support, the other ends connected to each two bars, which are hinged to the apparatus frame, the linkages between feet supports and bars forming a parallelogram like structure, wherein the length of the linkages decide the postures performed by the feet supports, the postures available from flat horizontal like posture to a toe heel posture during a revolution of the crank device.

12.

A motion device according to claim 11, wherein linkages are connected to any rotating part of the motion device, as said wheel, arms or feet supports, the linkages also connected to bars forming handles, which is made to pivot as result of the revolving of the motion device, the pivoting of the handles form part of the training apparatus exercise mode.

13.

A motion device according to claim 12, wherein two pairs of linkages which at the one end parts are connected on a part of each foot support, the other ends connected to each two bars, which are hinged to the apparatus frame, the linkages between feet supports

and bars forming a parallelogram like structure, the bars forming handles which move in a swaying fashion when motion device is revolving.

14.

A motion device according to claim 10, wherein the means for posture stabilisation consist of two set of wheels or any partial rotateable member, a first set fixed to feet support brackets a second set fixed to lower parts of handles, the said wheels and handles interconnected with belts or wires, wherein the rotational position of the wheel and the connection of wires or belts between said wheels decide the toe heel postures performed by the feet supports, the postures available from flat horizontal like posture to a toe heel posture during a revolution of the crank device.

15.

A motion device according to claim 14, wherein said wheel or rotateable member is rotationable adjustable by use of manual means or by automated means.

16.

A motion device according to claim 15, wherein means for manual adjustments consist of a bolt with fittings in to slots in said one of rotateable wheel or member, or with automated means consisting of a motor with gears connected to said rotateable wheel or member, the motor connected to an interface console of the apparatus having the said motioning device.

17.

A motion device according to any of claims 1-16, wherein secondary arms of the motioning device are adjustable in length, or where the point of connecting feet supports to the arms are adjustable along the length of the arms.

18.

A motion device according to claim 17, wherein said secondary arms have a number of slots along the length of said arms, where fixing means for the feet supports may be positioned.

19.

A motion device according to claim 17, wherein arms has worm gears or threaded bolts connected with motors which enables moving connecting point of feet supports along the length of the secondary arms.

20.

A motion device and training apparatus according to anyone of claims 1-19, wherein said feet supports are platforms or pedals provided with an actuateble tilt function being in transverse direction of the feet supports.

21.

A motion device and training apparatus according to claim 20, wherein the feet supports is platforms is fixed to supportive platform frames, wherein each frame is tiltable and fixedly attached to a body with an axle, tilt motion being limited by a bolt and a curved track, the curved track having at a location there-along an recess into which the bolt is forced by a spring, the bolt position being controlled by a lever which has two positions, the first position forcing the bolt into the curved track to give a tilt motion to the platform, and the second position relieving the force on the bolt to make the spring to force the bolt into the track recess.

22.

A motion device and training apparatus according to claim 1, wherein the motion device is connected to means of physical resistance, said means comprising a flywheel connected to a rotating part of the crank device by belt and pulleys, and wherein an eddy current brake system provides a braking or rotational speed retard force to the flywheel.

23.

A motion device and training apparatus according to anyone of claims 1 – 22, wherein the motioning device is operatively linked to a man machine interface system (MMI),

and or interface console for user input and monitoring of all functions incorporated within the training apparatus.

24.

A crank device and training apparatus according to claim 23, wherein an interface console or the man machine interface (MMI) system has input, control and adjustment means related to one or more of:

- paths of motion or style of training related to walking, jogging, running, climbing or skiing;
- stride length,
- angle of orbital or rectilinear path relative to the horizontal;
- level of brake force acting on the flywheel,
- personal workout levels,
- caloric burn rates,
- heart or pulse rate,
- physical condition of user

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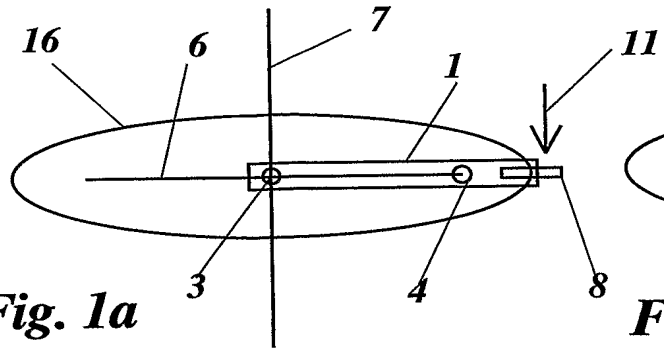

Fig. 1a

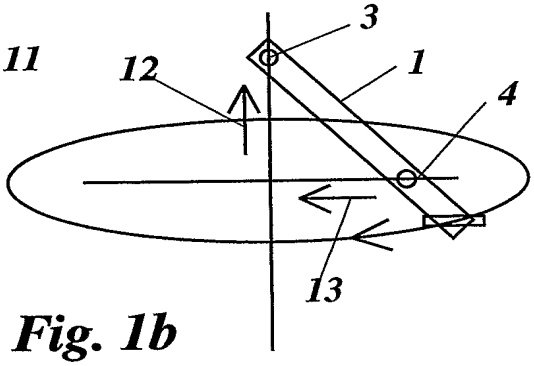

Fig. 1b

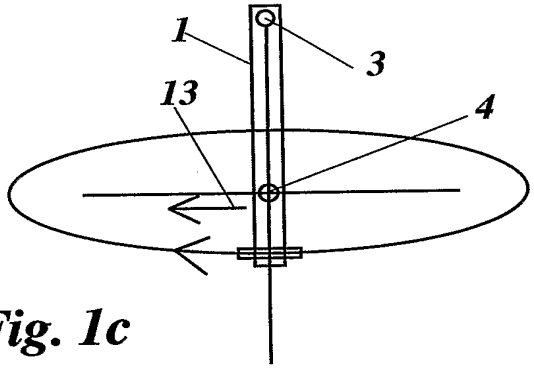

Fig. 1c

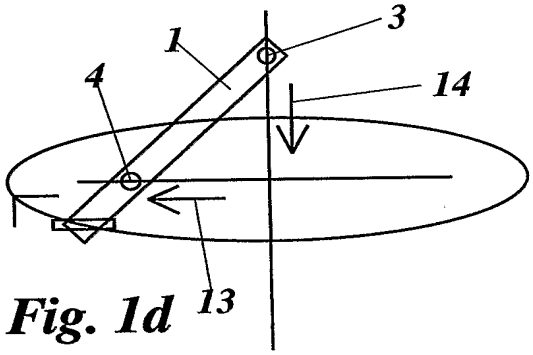

Fig. 1d

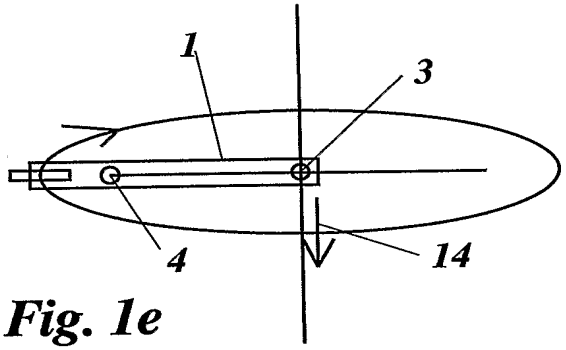

Fig. 1e

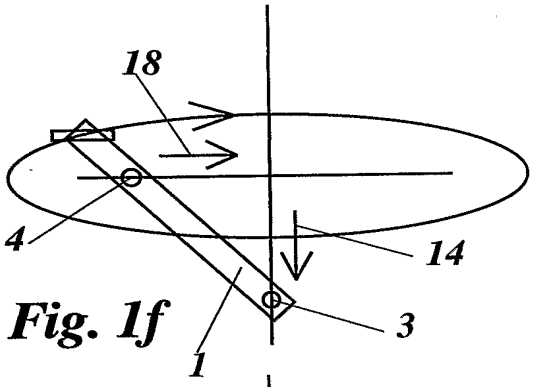

Fig. 1f

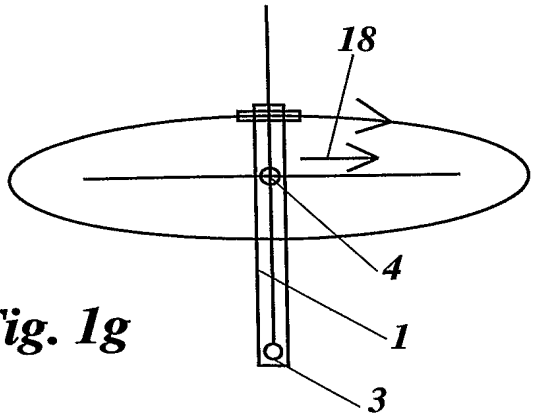

Fig. 1g

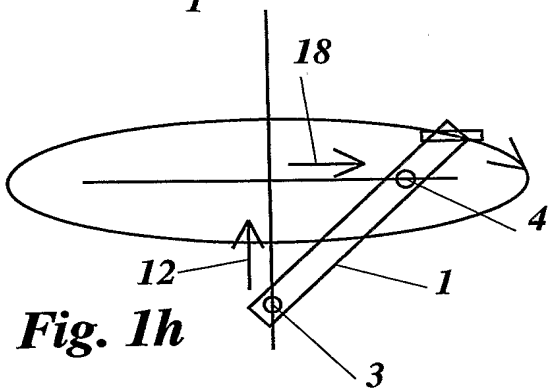

Fig. 1h

(Prior Art)

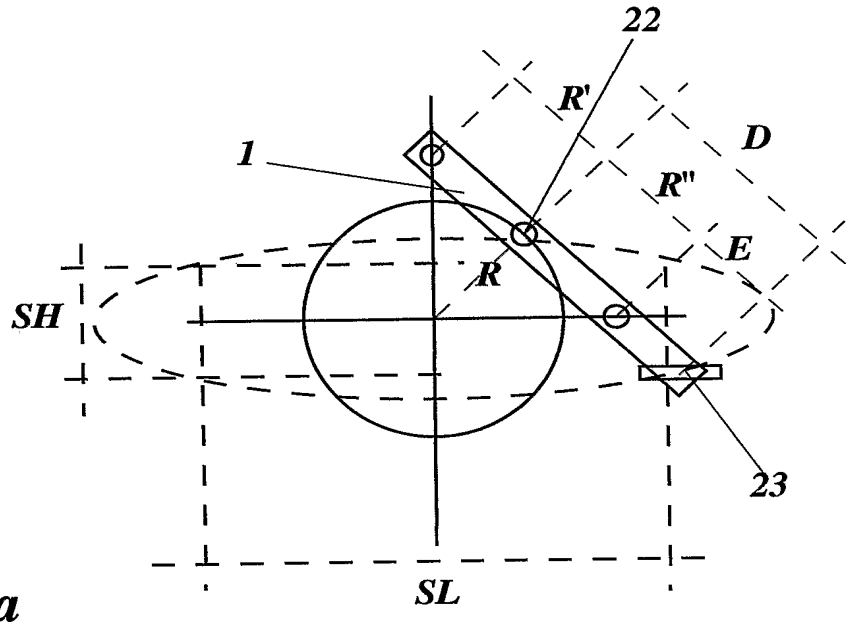

Fig. 2a

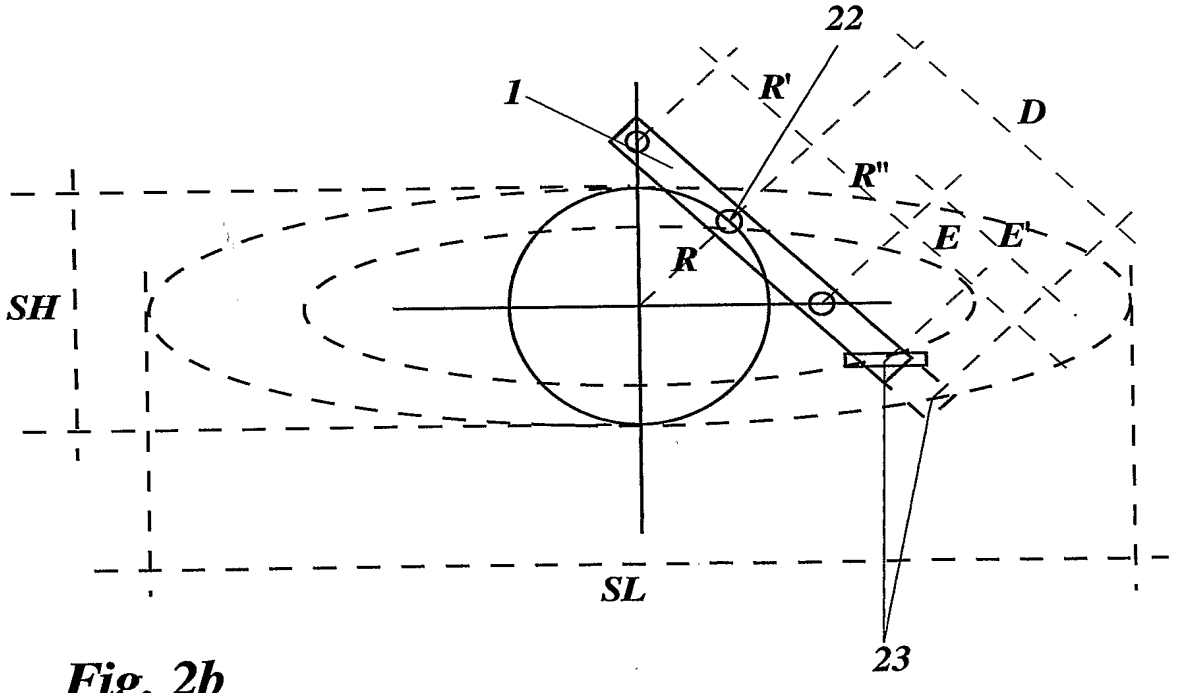

Fig. 2b

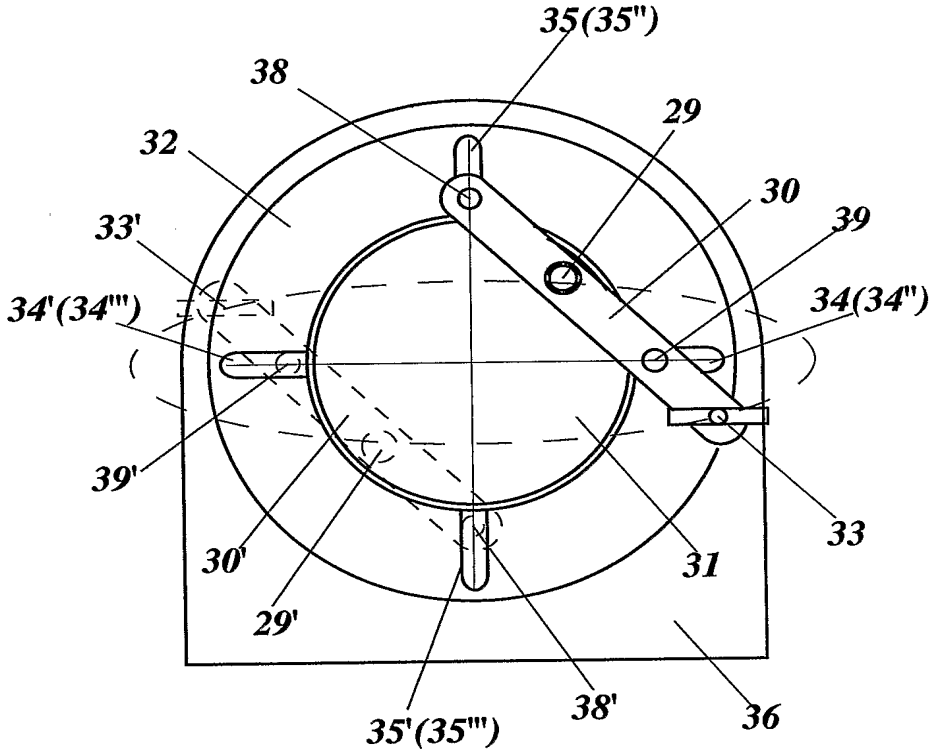
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Fig. 3

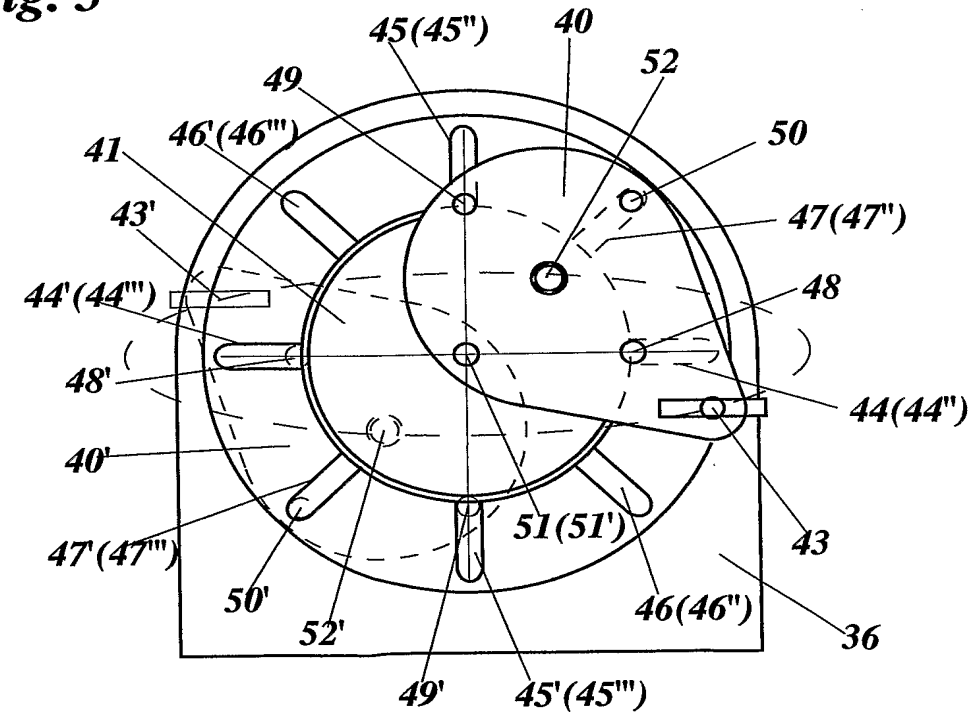
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Fig. 4

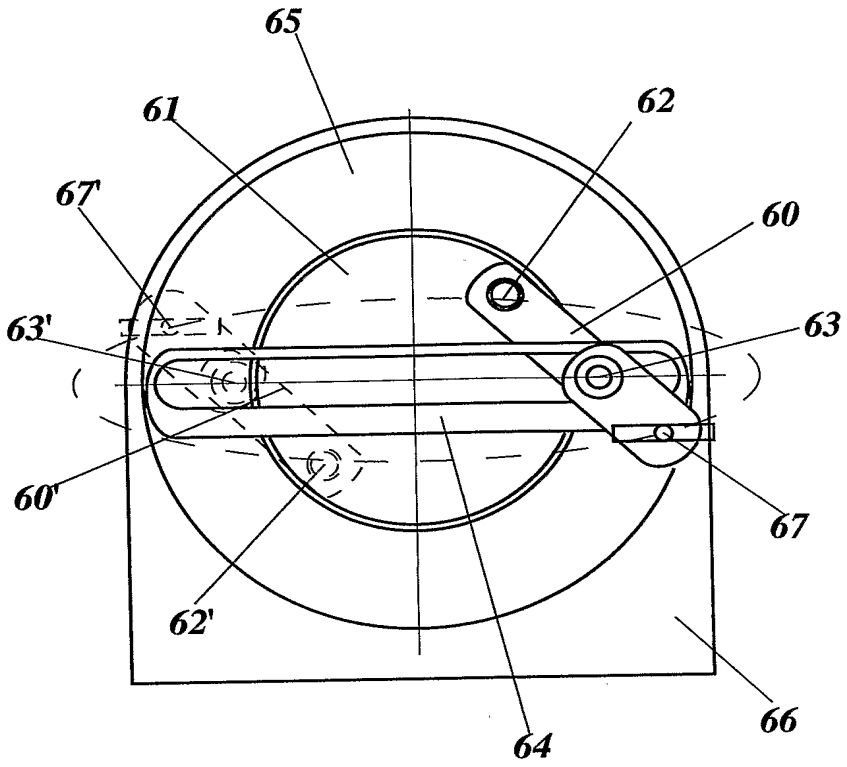

Fig. 5

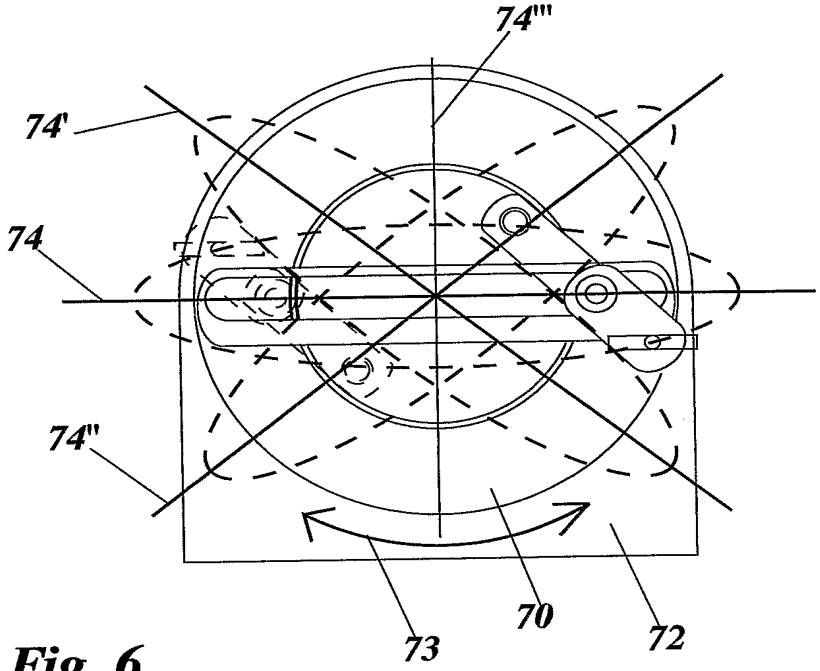

Fig. 6

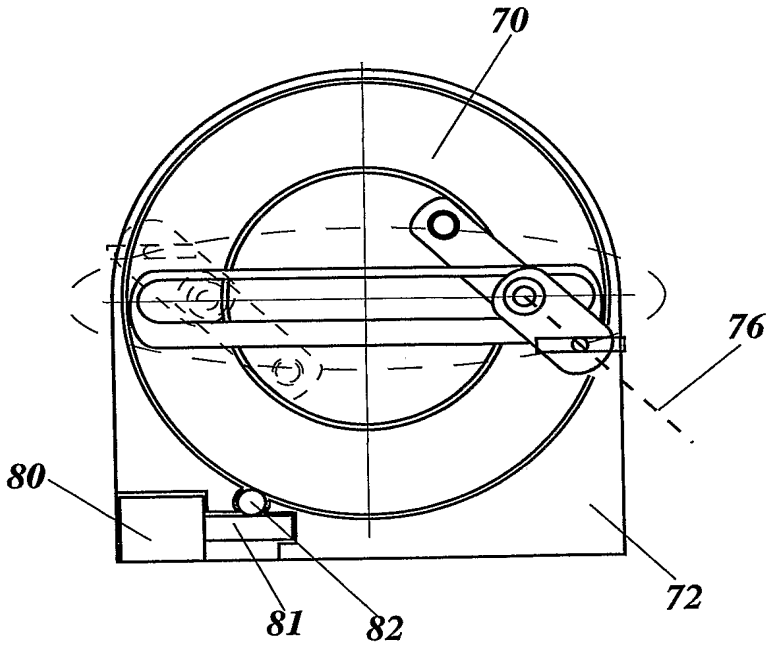

Fig. 7

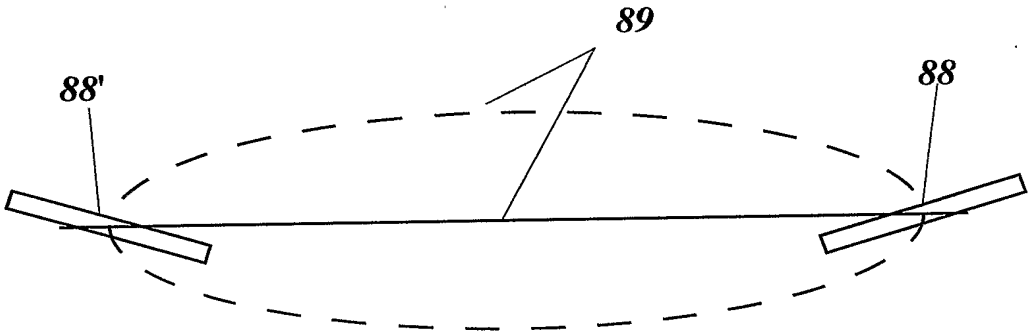

Fig. 8

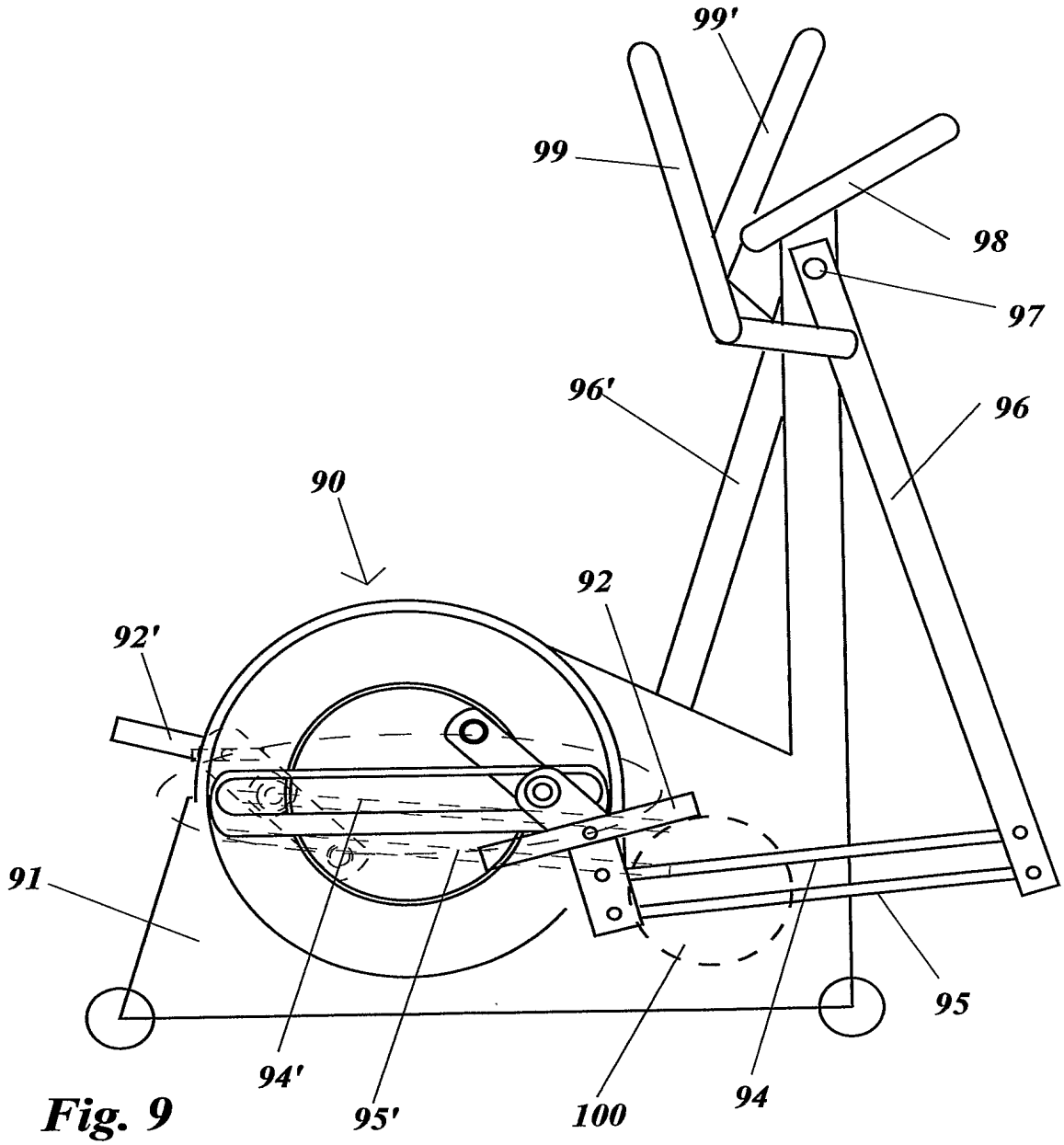

Fig. 9

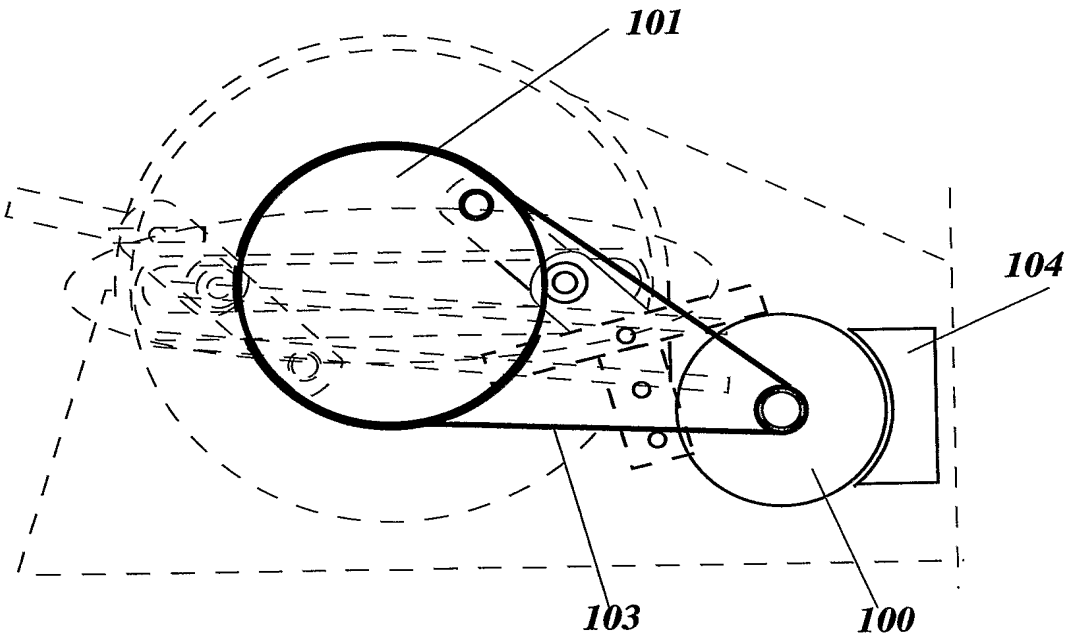

Fig. 10

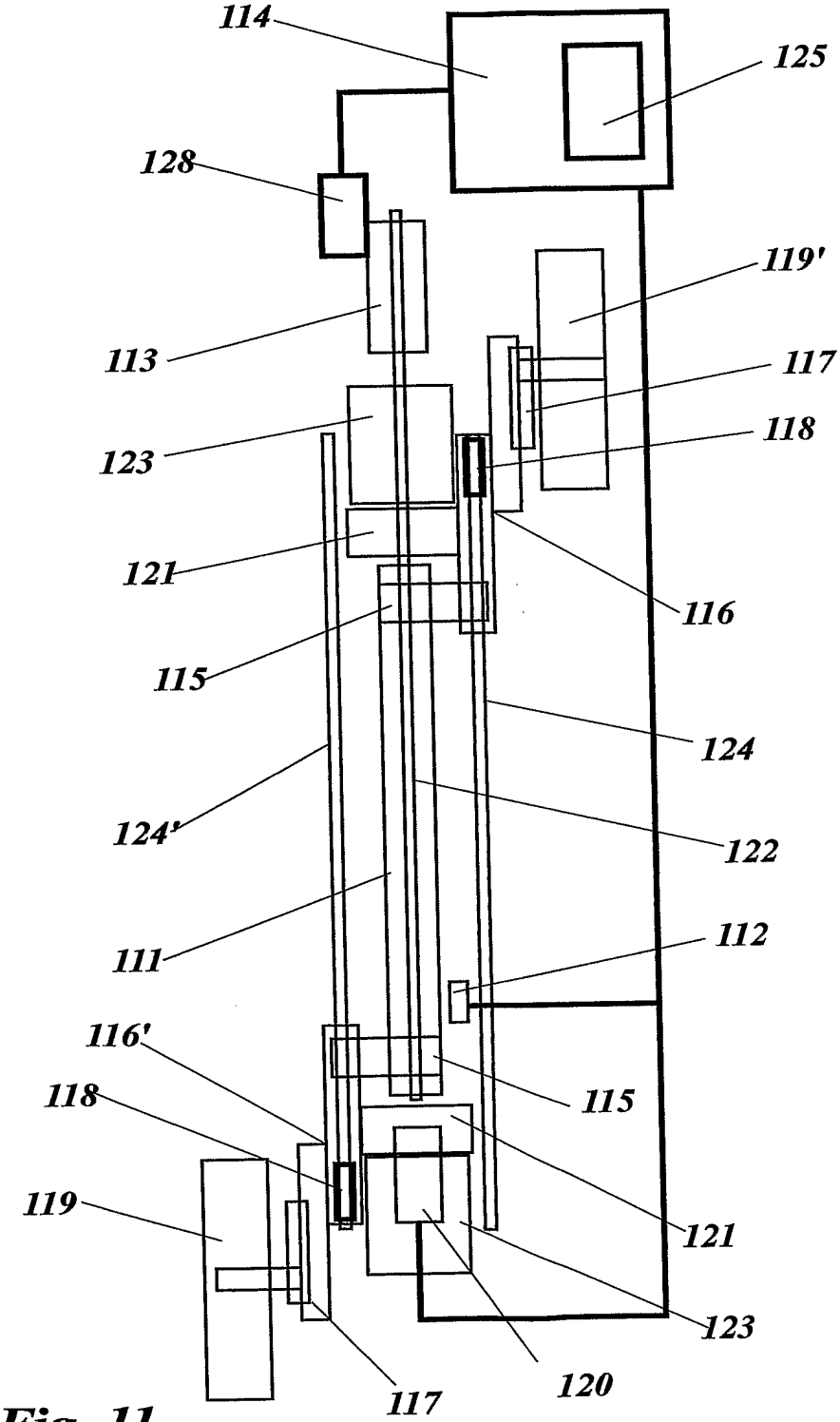
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Fig. 11

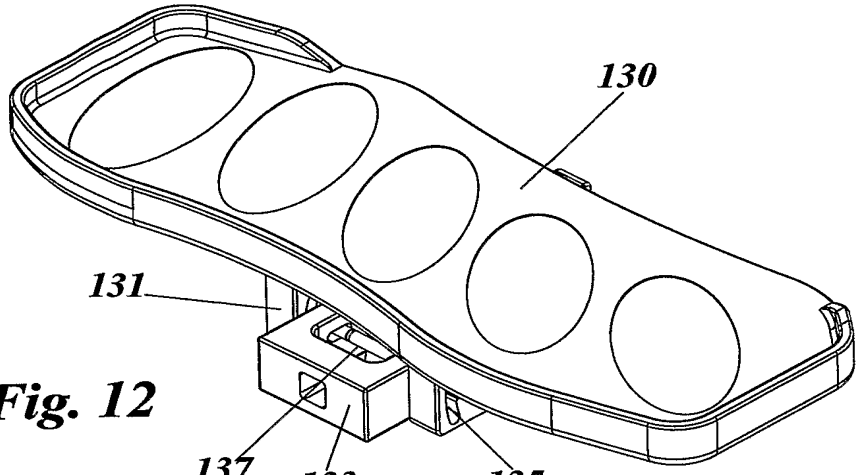

Fig. 12

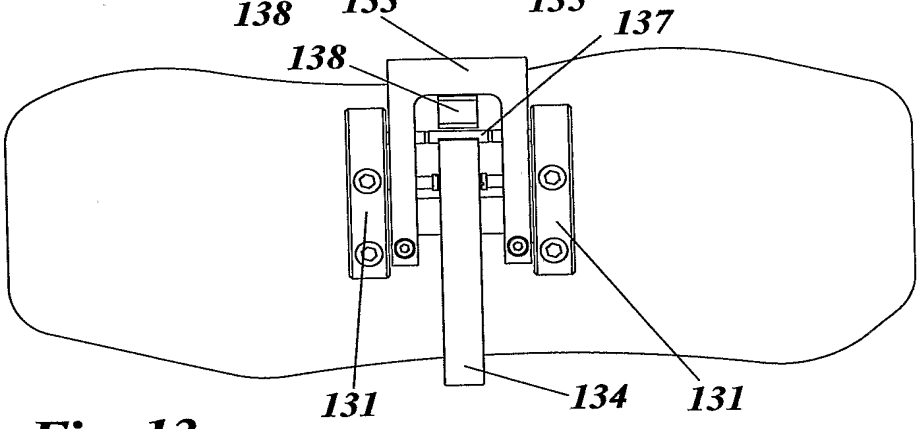

Fig. 13a

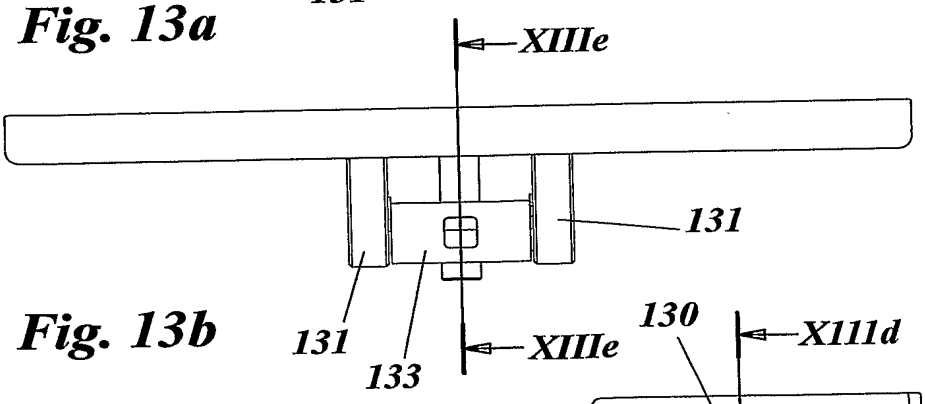

Fig. 13b

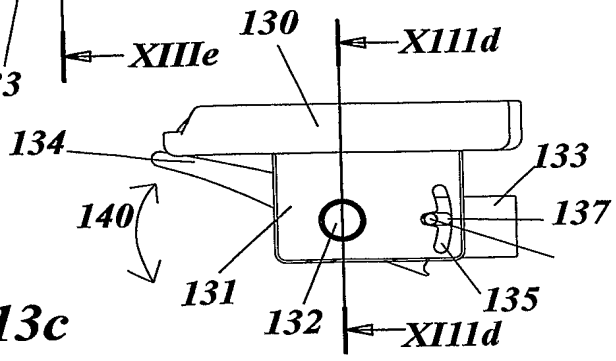

Fig. 13c

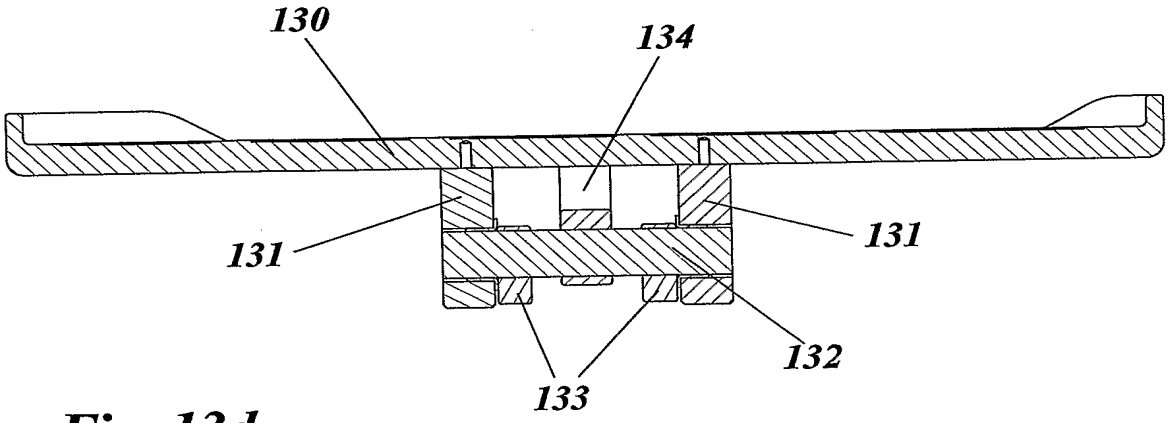

Fig. 13d

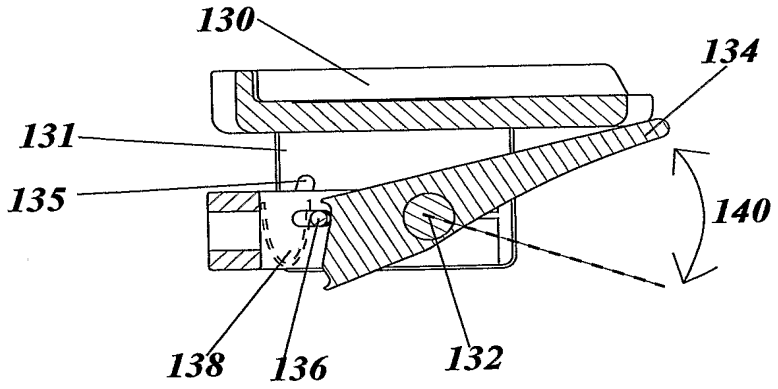

Fig. 13e

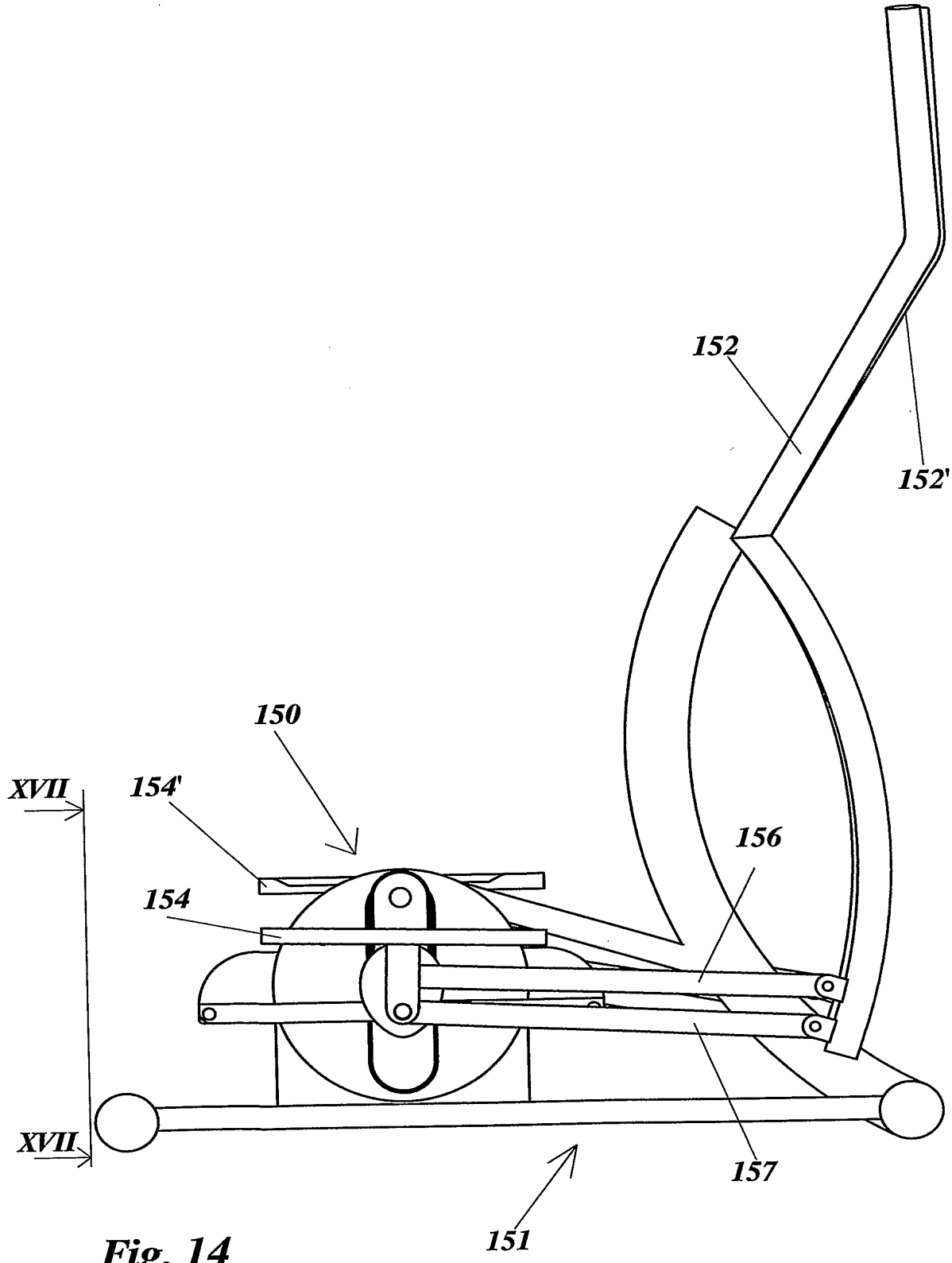

Fig. 14

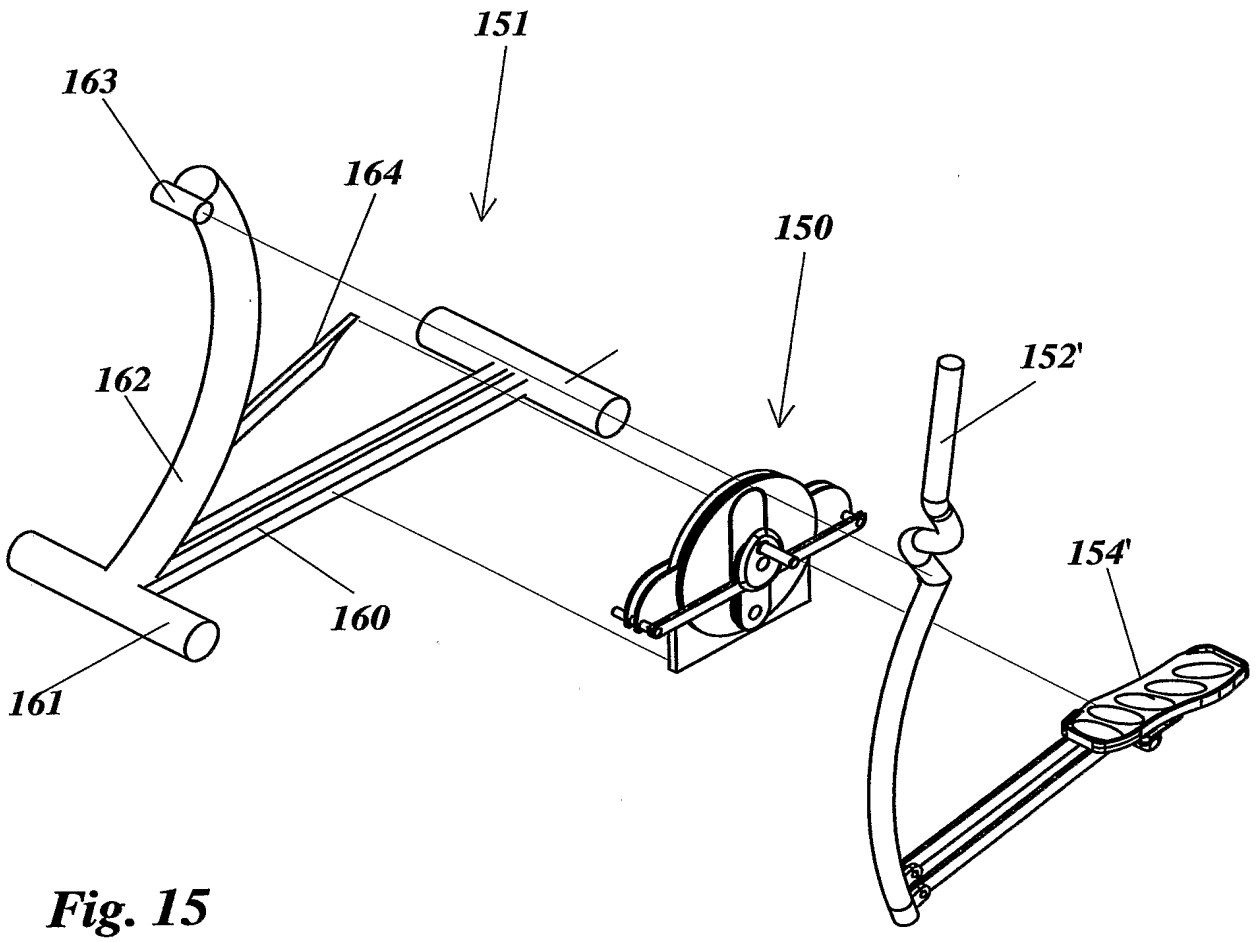

Fig. 15

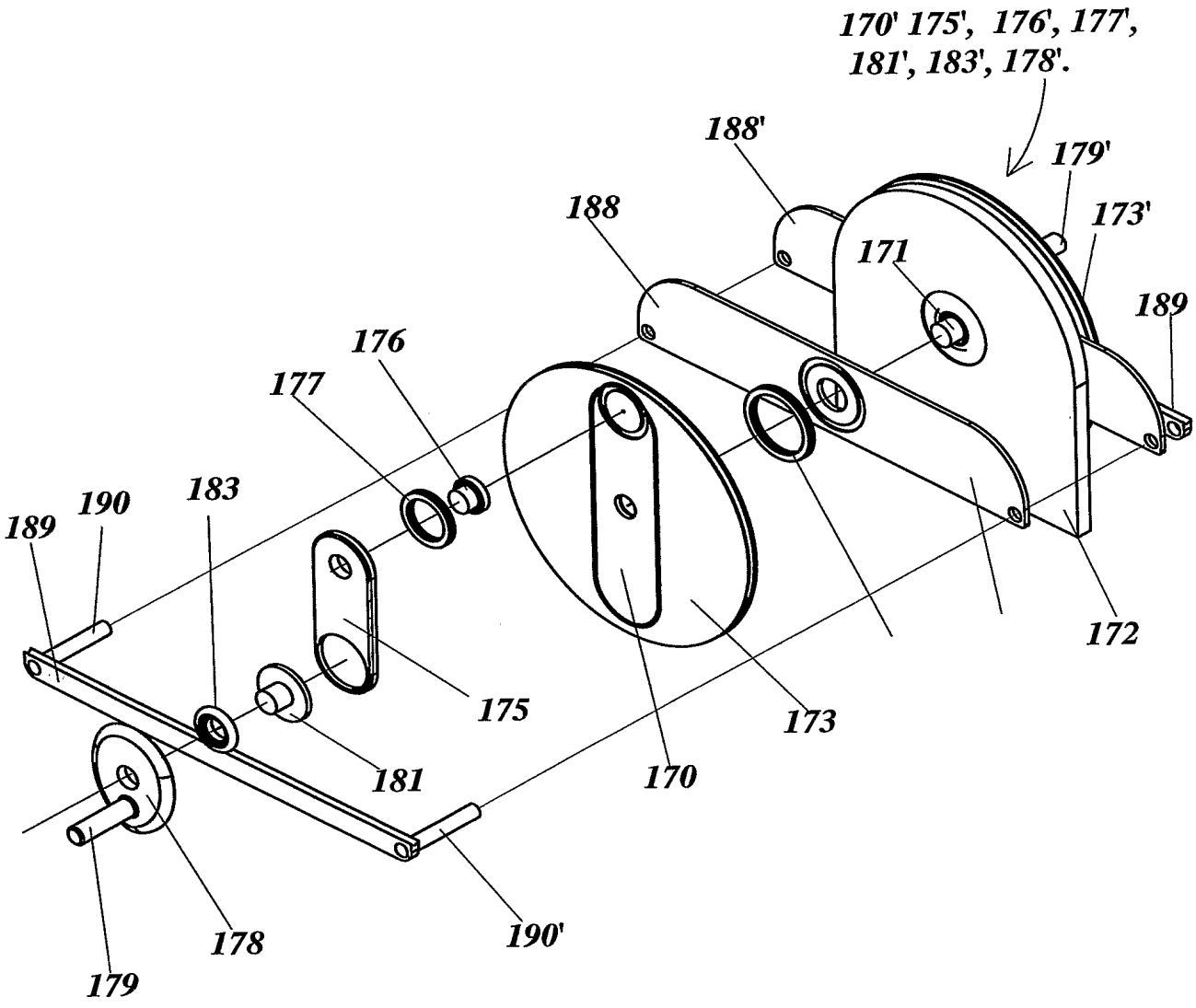
170' 175', 176', 177',
181', 183', 178'.
188'
179'
188
173'
171
189
176
177
189
190
183
172
175
173
181
170
178
190'
179

Fig. 16

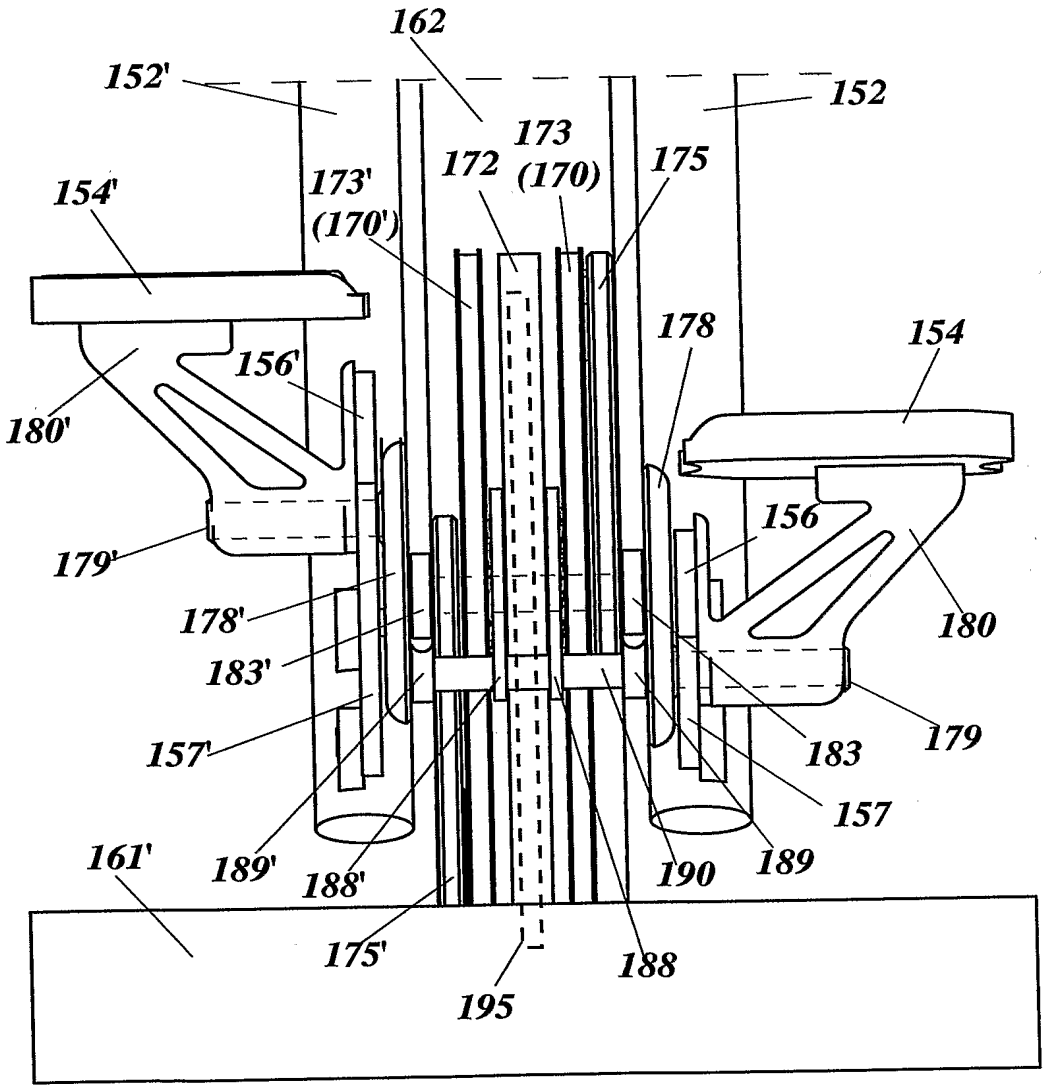
162
152'
152
173
(170)
172
175
173'
(170')
154'
154
178
156'
180'
156
179'
180
178'
183'
179
157'
183
157
161'
189'
188'
190
189
175'
188
195

Fig. 17

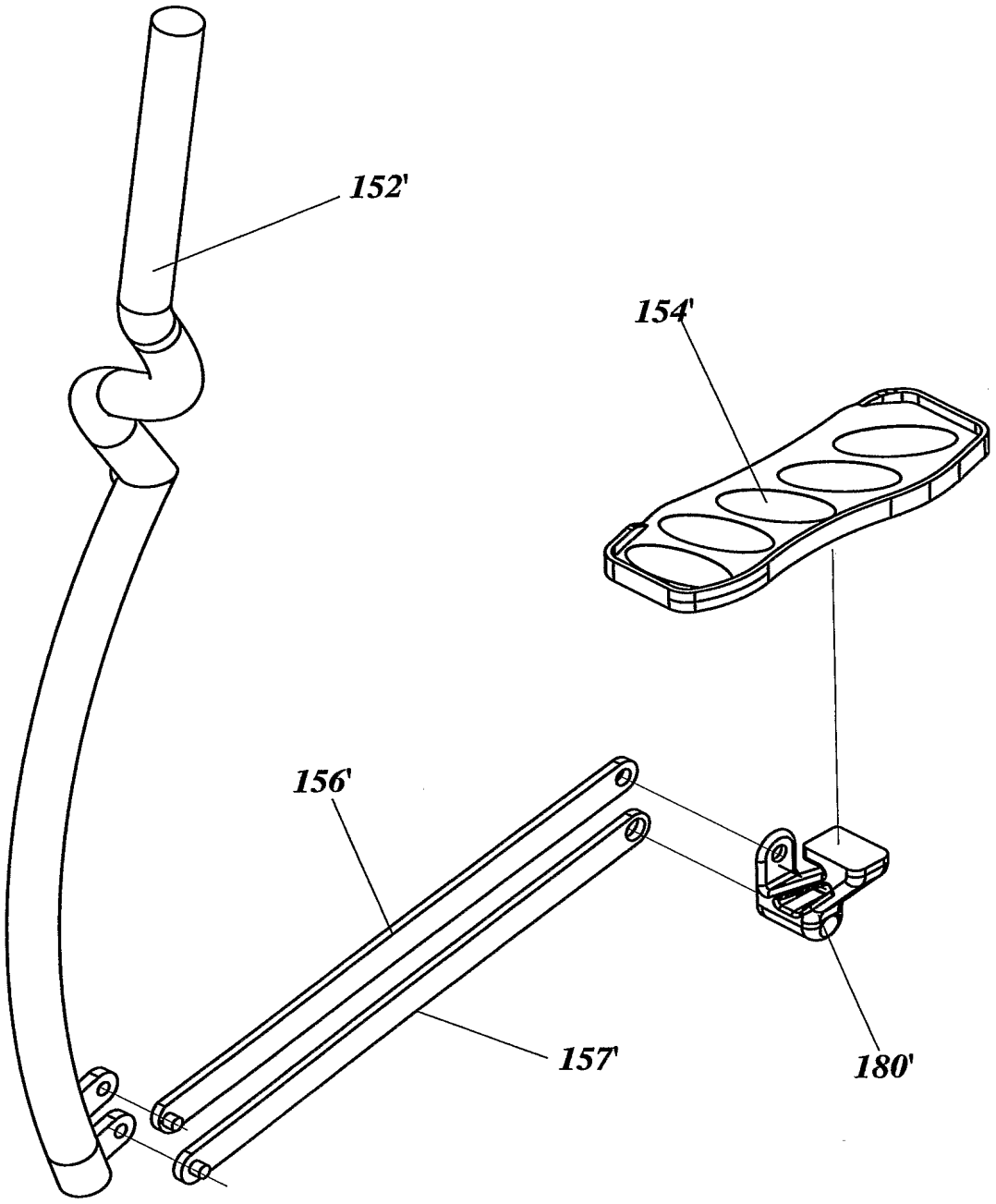

Fig. 18

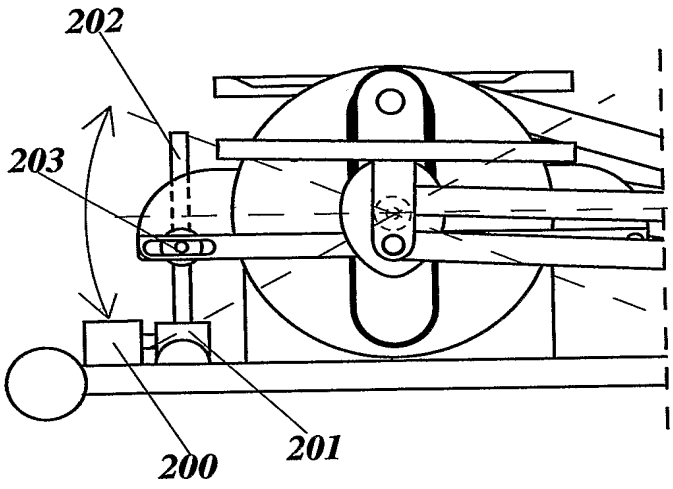

Fig. 19b

Fig. 19a

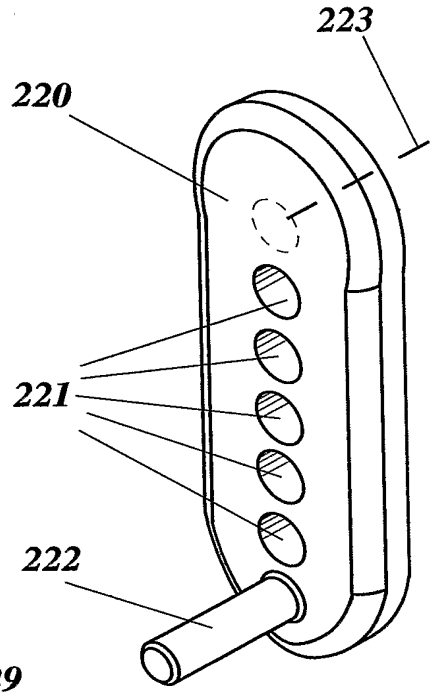

Fig. 20a

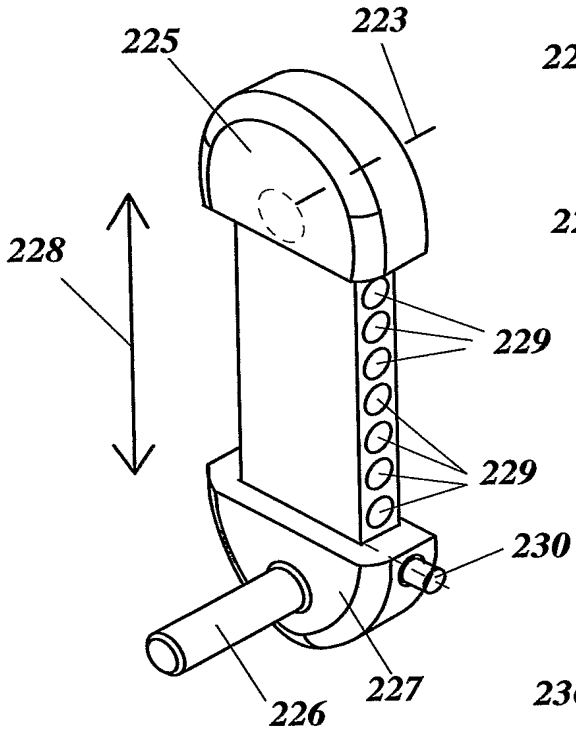

Fig. 20b

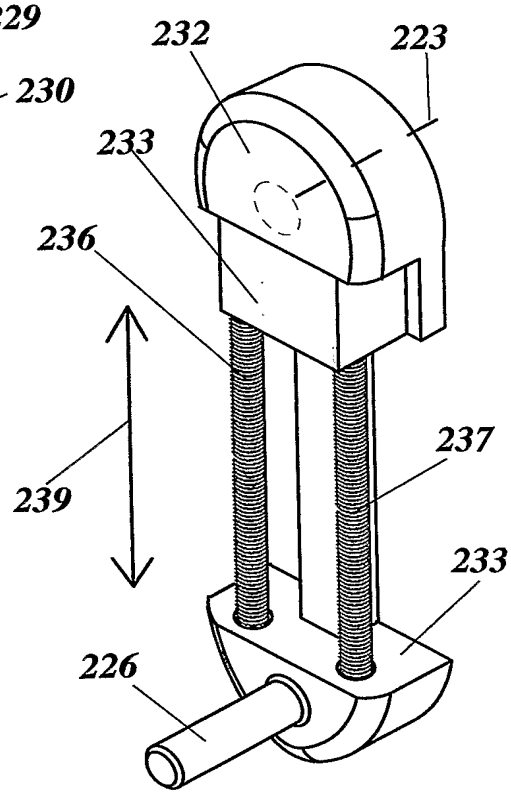

Fig. 20c

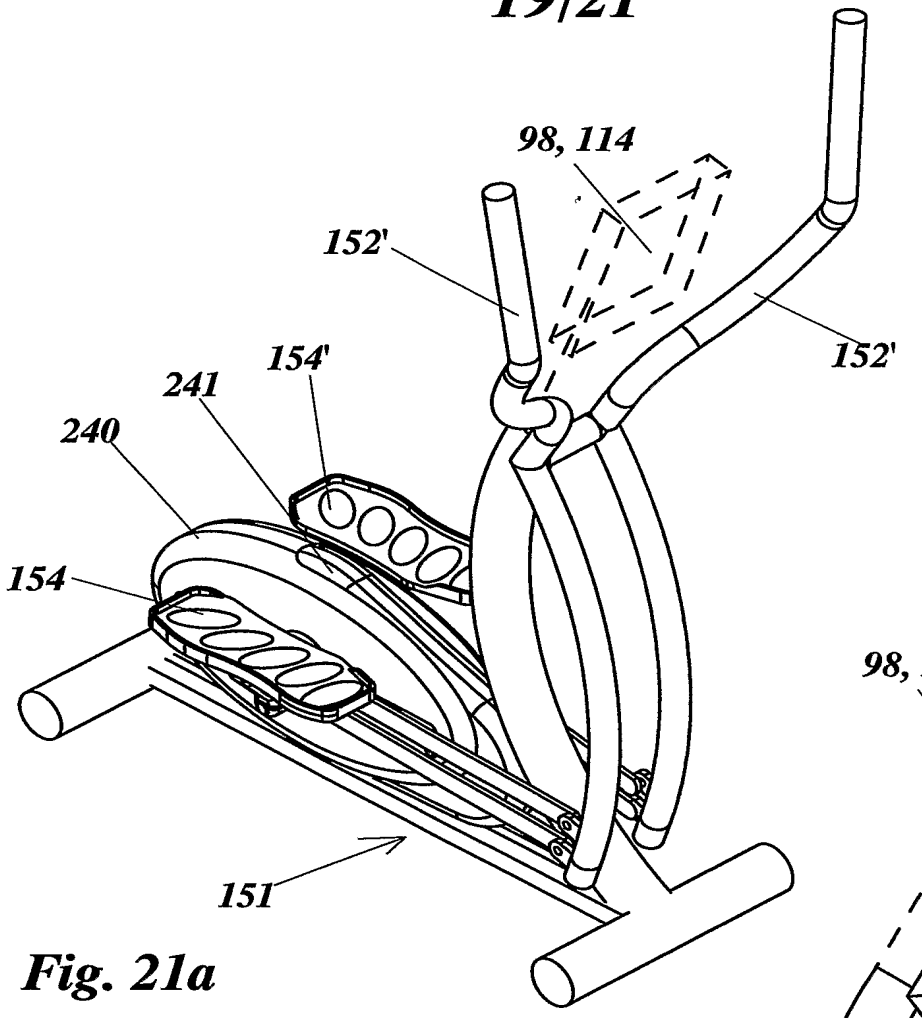

Fig. 21a

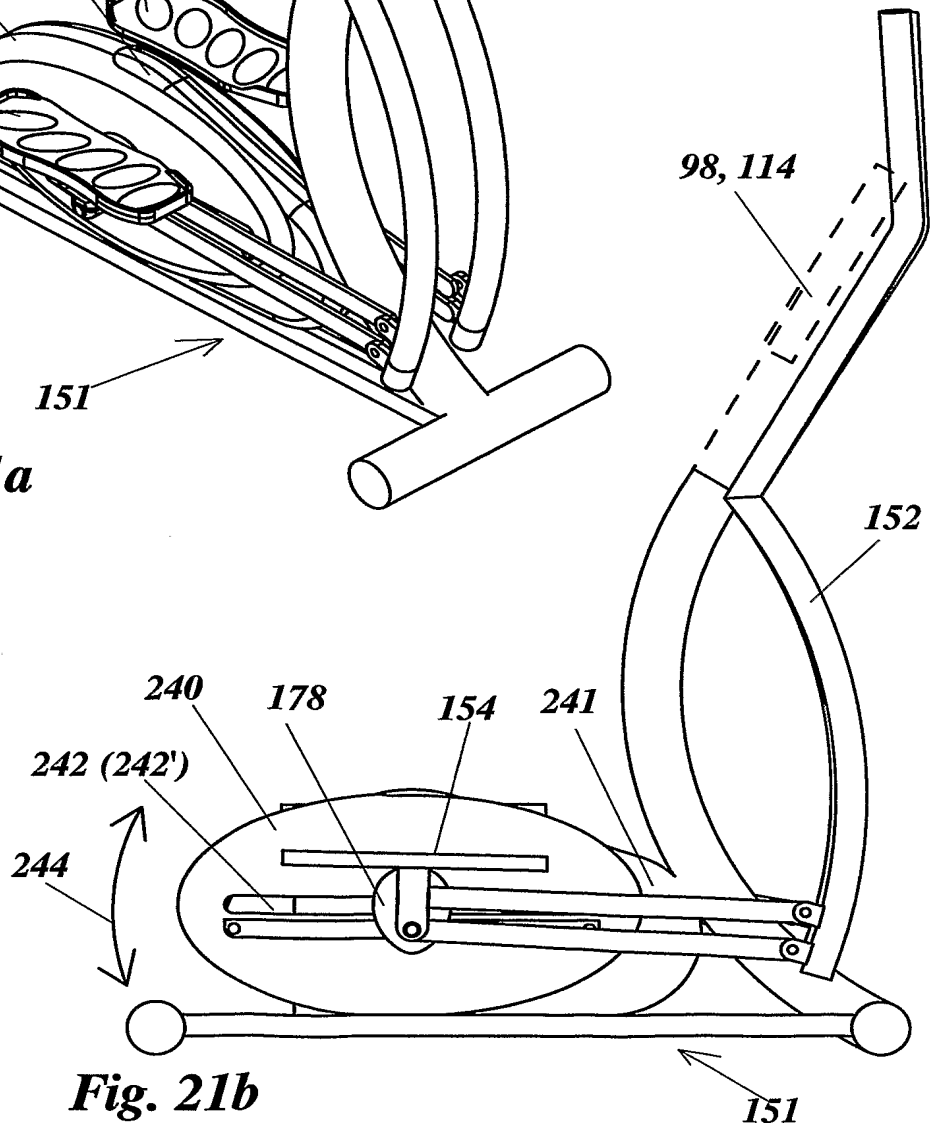

Fig. 21b

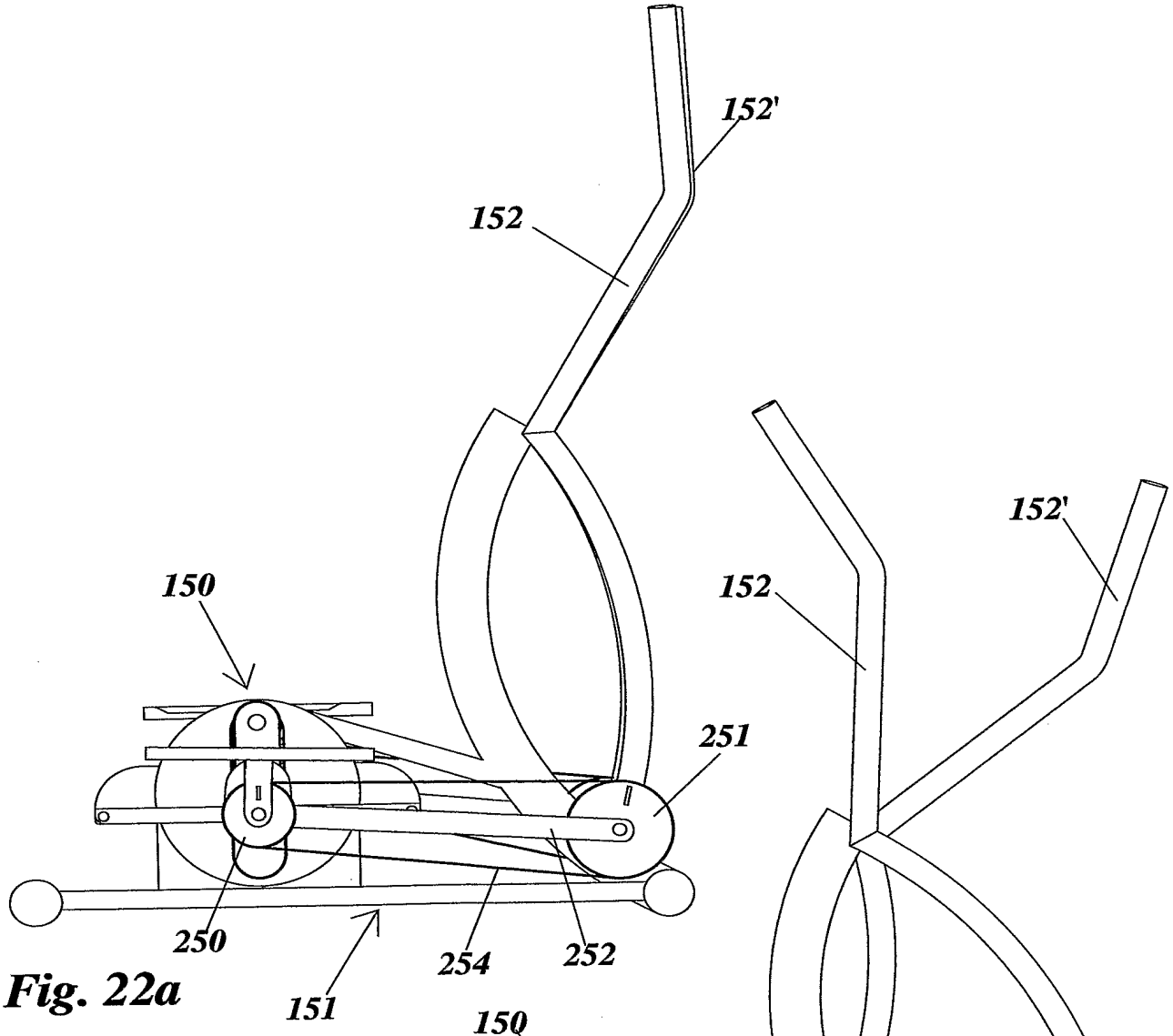

Fig. 22a

Fig. 22b

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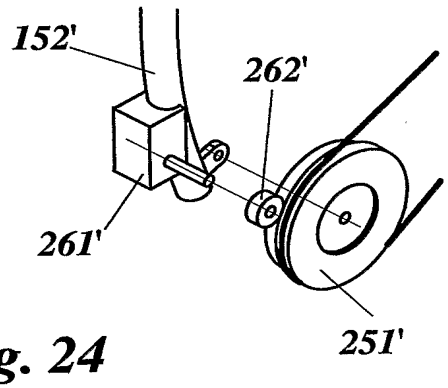

Fig. 24

Fig. 23

INTERNATIONAL SEARCH REPORT

International application No
PCT/NO2006/000017

A. CLASSIFICATION OF SUBJECT MATTER
INV. A63B23/04 A63B22/08 A63B24/00 A63B23/035

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 334 836 B1 (SEGASBY MARK) 1 January 2002 (2002-01-01) the whole document	1
A	US 5 924 963 A (MARESH ET AL) 20 July 1999 (1999-07-20) the whole document	11-13
A	US 6 688 192 B1 (BADARNEH ZIAD) 10 February 2004 (2004-02-10) cited in the application	20,21
A	US 2004/005960 A1 (CHANG HUANG-TUNG) 8 January 2004 (2004-01-08)	
A	US 6 135 923 A (STEARNS ET AL) 24 October 2000 (2000-10-24)	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
4 May 2006	12/05/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Squeri, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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